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DEPARTMENT OF THE NAVY

ATLANTIC DIVISION, NAVAL FACILITIES ENGINEERING COMMAND

NAVAL BASE, NORFOLK, VIRGINIA

RAC CONTRACT NO:
N62470-93-B-3032

NAVFAC
SPECIFICATION NO:
05-96-6834

APPROPRIATION:
ERN

GROUNDWATER REMEDIATION
SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

at the

ALLEGANY BALLISTICS LABORATORY

MINERAL COUNTY, WEST VIRGINIA

DESIGN BY:

CH2M HILL

625 Herndon Parkway
Herndon, VA 22070

SPECIFICATION PREPARED BY:

STRUCTURAL: SCOTT McCOY, P.E.

MECHANICAL: JORGE BUSTILLOS, P.E.

CIVIL: KATHLEEN HALL, E.I.T.

ELECTRICAL: DAVID DOAR, P.E.

ARCHITECTURAL: LUIGI GRANDE, AIA

PROCESS: LEE DAVIS, E.I.T.

SPECIFICATION SUBMITTED BY: STEWART L. BARNES, P.E.

DATE: MAY 23, 1997

SPECIFICATION APPROVED BY:

ENVIRONMENTAL DIVISION DIRECTOR: P.N. SMITH, P.E.

SPECIFICATION BRANCH HEAD: E.J. GALLAHER, IV, P.E.

ENGINEERING AND DESIGN DIVISION DIRECTOR: W.H. CRONE, P.E.

FOR EFD FOR COMMANDER, NAVFAC:

DATE:

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03/96

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.. -- End of Section --

SECTION 01115

GENERAL PARAGRAPHS (REMEDIAL ACTION CONTRACTS)

07/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

- | | |
|-----------------------|--|
| 29 CFR 1910 | Occupational Safety and Health Standards |
| 29 CFR 1926 | Safety and Health Regulations for Construction |
| 29 CFR 1926-SUBPART V | Power Transmission and Distribution |

CORPS OF ENGINEERS (COE)

- | | |
|-----------------|--|
| COE EP 1110-1-8 | (1993) Construction Equipment Ownership and Operating Expense Schedule |
| COE EM-385-1-1 | (1992) Safety and Health Requirements Manual |

MILITARY STANDARDS (MIL-STD)

- | | |
|-------------|---|
| MIL-STD-461 | (Rev. D) Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference |
| MIL-STD-462 | (Rev. D) Measurement of Electromagnetic Interference Characteristics |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|---|
| NFPA 241 | (1993) Safeguarding Construction, Alteration, and Demolition Operations |
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1.2 PRECONSTRUCTION SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the basic contract.

1.2.1 SD-09, Reports

- a. On-Site Area Work Plan G
- b. Off-Site Area Work Plan G

1.2.1.1 On-Site Area Work Plan

On-site area work is defined as required work located in the area of

suspected soil contamination. Items of construction included in this area are process yard piping from the treatment building to the extraction well heads, yard electrical, and communication systems, plant discharge piping, and appurtenant construction.

1.2.1.2 Off-Site Area Work Plan

Off-site area work is defined as required work located outside of the area of suspected soil contamination. Items of construction included in this area are treatment building construction, elevated water storage tank construction, process equipment installation, site utilities, site improvements, and appurtenant construction.

1.2.1.3 Work Plan

Submit Work Plans consisting of the following elements:

- a. Narrative: Provide a brief description of the project objectives, scheduling, sampling and analysis requirements, decontamination procedures, removal and excavation procedures, and storage, transportation, and treatment requirements; and a detailed sequence of events for the construction, extraction, and treatment methods.
- b. Technical Specifications: Provide, in an amendment format, any additional specifications and any modifications to the contract specifications required to accurately describe the materials and work procedures envisioned to satisfy the requirements of the delivery order. Contact Code 406, Specifications Branch, Engineering and Design Division, LANTNAVFACENGCOM, (757) 322-4301, for availability of guide specification sections for those sections required, but not included in the contract documents.
- c. Shop drawings: Shop drawings shall detail and describe components of the project not currently indicated on the contract drawings such that the shop drawings and the contract drawings, when taken together, provide a complete representation of the project requirements. Shop drawings shall be prepared and sealed by a registered professional engineer. Shop drawings shall include:
 - (1) Erosion Control Plan in accordance with State and local regulations.
 - (2) Treatment system drawings.
- d. Environmental Protection Plan: At the preconstruction conference, meet with the Resident Officer in Charge of Construction's (ROICC's) Navy Technical Representative (NTR) to discuss environmental protection requirements for the project. Prepare and submit an Environmental Protection Plan in accordance with Section C, Part 4.0, of the basic contract, and as specified herein.
 - (1) Hazardous materials (HM) to be brought onto the station: Any hazardous materials planned for use on the station shall be included in the station Hazardous Material Tracking Program maintained by the safety department. To assist in this effort, the Contractor shall submit a list (including quantities) of HM to be brought to the station and copies of the corresponding material

safety data sheets (MSDS). This list shall be submitted to the ROICC NTR. At project completion, any hazardous material brought onto the station shall be removed from the site by the Contractor.

The Contractor shall account for the quantity of HM brought to the station, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as a HM and shall be removed by the Contractor, or (2) may be a hazardous waste, which shall then be removed as specified herein.

(2) Hazardous waste (HW) generated: The Environmental Protection Plan shall list and quantify any HW to be generated during the project.

(3) Storage of hazardous waste: In accordance with station regulations, hazardous waste shall be stored near the point of generation up to a total quantity of 1 quart of acutely hazardous waste or 55 gallons of hazardous waste. Any volume exceeding these quantities shall be moved to an HW permitted area within 3 days. Prior to generation of HW, contact the ROICC NTR for labeling requirements for storage of hazardous wastes.

(4) Minimization of hazardous waste: In accordance with station regulations, the Contractor should substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

(5) Environmental conditions likely to be encountered during this project: Contact the ROICC NTR for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

(6) Permitting plans for any transportation and disposal, excavation, or construction of hazardous waste that will require an environmental permit from an issuing agency: The Contractor is responsible for generating the permits and delivering the completed documents to the ROICC NTR. The ROICC NTR will review the permits and the Contractor shall file the documents with the appropriate agency and complete disposal with the approval of the ROICC NTR. Correspondence with the State concerning the environmental permits and completed permits shall be delivered to the ROICC NTR.

(7) Environmental Protection Plan format

ENVIRONMENTAL PROTECTION PLAN

Contracting Organization

Address and Phone Numbers

1. Hazardous materials to be brought onto the station
2. MSDS package
3. Employee training documentation
4. HW storage plan

ENVIRONMENTAL PROTECTION PLAN

Contracting Organization

Address and Phone Numbers

5. HW to be generated
 6. Preconstruction Survey results
 7. Permitting requirements identified
- e. Health and Safety Plan: Provide a site specific Health and Safety Plan (HASP) in accordance with Section C, Part 3.0, of the basic contract. The HASP shall include, but is not limited to, the following:
- (1) Names of the health and safety officer and names of alternates responsible for health and safety.
 - (2) 29 CFR 1910.
 - (3) 29 CFR 1926.
 - (4) 29 CFR 1926-SUBPART V, tagout and lockout procedures.
 - (5) Contract Clause "FAR 52.236-13, Accident Prevention."
 - (6) Contract Clause "FAR 52.223-3, Hazardous Material Identification and Material Safety Data."
 - (7) NFPA 241.
- f. QC Plan: Provide a QC Plan in accordance with Section C, Part 6.0, of the basic contract, and as specified herein.
- (1) Table of Contents
 - I. QC ORGANIZATION
 - II. NAMES AND QUALIFICATIONS
 - III. DUTIES, RESPONSIBILITY, AND AUTHORITY OF QC PERSONNEL
 - IV. OUTSIDE ORGANIZATIONS
 - V. APPOINTMENT LETTERS
 - VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
 - VII. TESTING LABORATORY INFORMATION
 - VIII. TESTING PLAN AND LOG
 - IX. PROCEDURES TO COMPLETE REWORK ITEMS
 - X. DOCUMENTATION PROCEDURES
 - (2) Submittal Register: As part of the QC Plan, submit a completed Submittal Register to document quality control for materials, inspection, and testing in accordance with Section C, Part 7.0 of the basic contract. A copy of the Submittal Register is provided at the end of this section.
 - (3) Testing laboratory qualifications: As part of the QC Plan, submit qualifications for each laboratory which shall be used in accordance with Section C, Part 6.0, of the basic contract. Laboratories engaged in hazardous materials testing shall meet the

requirements of Section C, Part 6.0 of the basic contract.

- g. Sampling and Analysis Plan: Provide a Sampling and Analysis Plan describing sampling and analyses requirements for the delivery order, including sampling and analyses required during the operational period to verify the system is operating within required parameters. The plan shall contain a Field Sampling Plan and a Quality Assurance Plan.

1.2.2 Forwarding Preconstruction Submittals

Within 45 calendar days of issuance of the delivery order, and before procurement, fabrication, or mobilization, submit to the Commander, LANTNAVFACENGCOM, Code 18221, Attn: Mr. Chris Penney, 1510 Gilbert Street, Norfolk, VA 23511-2699, Architect-Engineer, CH2M HILL, 625 Herndon Parkway, Herndon, VA 20170, Attn: Mr. Stewart L. Barnes, P.E., and to distribution as directed by the Code 18 NTR, the Work Plan, complete as specified. The Architect-Engineer shall review the Work Plan for the Code 18 NTR to determine compliance of the Contractor's Work Plan with the requirements of the contract documents for this delivery order.

1.2.3 Review Comments

The Contractor's Work Plan shall be reviewed. The Code 18 NTR shall compile and coordinate Government review comments, and forward consolidated review comments to the Contractor. Review comments on the Work Plan shall be resolved, and Work Plan modified as required. After the correction of the Work Plan, submit one corrected final copy to the Commander, LANTNAVFACENGCOM, Code 18221, Attn: Mr. Chris Penney, 1510 Gilbert Street, Norfolk, VA 23511-2699 for final review. The Work Plan shall be approved prior to commencement of any other work associated with this delivery order.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0, of the basic contract.

1.3.1 SD-09, Reports

- a. Work Plan

1.3.2 SD-18, Records

- a. As-Built records G
- b. Environmental Conditions Report G
- c. Status reports G
- d. Network Analysis Diagram G
- e. QC meeting minutes G
- f. Test Results Summary Report G
- g. Contractor Production Report G
- h. QC Report G

- i. Rework Items List G
- j. Permits G
- 1. Contractor's Closeout Report G

1.3.2.1 As-Built Records

Maintain two sets of full size contract drawings and two sets of full size approved shop drawings marked to show any deviations which have occurred, including buried or concealed construction and utility features revealed during the course of construction. Record horizontal and vertical locations of buried utilities that differ from the contract drawings. These drawings shall be available for review by the ROICC NTR at any time. At the completion of the work, deliver marked sets of the contract drawings to the ROICC NTR. The Contractor shall indicate on the drawings the locations of confirmation samples. The Contractor shall incorporate shop drawing deviations, and deliver one complete set of the shop drawings to the ROICC NTR.

1.3.2.2 Environmental Conditions Report

Prior to starting work, perform a preconstruction survey with the ROICC NTR. Take photographs showing existing environmental conditions on and adjacent to the site. Prior to starting work, submit the results of the survey in an Environmental Condition Report to the ROICC NTR.

1.3.2.3 Contract Management System (CMS)

The CMS shall be a system able to provide, as a minimum, the activities in sorts or groups as specified in the basic contract and any subsequent delivery orders.

- a. Status reports: Status reports shall comply with the basic contract and any subsequent delivery orders. Submit a Technical Progress Report, Cost Performance Report, modification log, time-scaled logic diagram, and Waste Materials Report. Submit the first delivery order status report approximately 15 days after the end of the month in which the Contractor's Work Plan was approved. Thereafter, submit status reports every 30 days. Status report periods shall be consistent with the invoice reporting periods.
- b. Network Analysis Diagram: Within 30 days of approval of the Contractor's Work Plan, submit a Network Analysis Diagram in accordance with the basic contract and any subsequent delivery orders.

1.3.2.4 QC Meeting Minutes

The QC representative shall document QC meetings by delivering copies of the minutes to the ROICC NTR within 3 calendar days after each QC meeting. The submittals shall comply with Section C, Part 6.0 of the basic contract.

1.3.2.5 Test Results Summary Report

A summary report of field tests and laboratory analytical results shall be submitted to the ROICC NTR within 30 days after laboratory receipt of samples and in accordance with Section C, Part 6.0 of the basic contract.

1.3.2.6 Contractor Production Report (CPR)

The CPR shall be prepared and submitted daily to the ROICC NTR in accordance with Section C, Part 6.0, of the basic contract.

1.3.2.7 QC Report

The QC Report shall be submitted by the QC representative to the ROICC NTR every day work is performed, material is delivered, direction is pending, or a labor force is present in accordance with Section C, Part 6.0, of the basic contract.

1.3.2.8 Rework Items List

The QC representative shall deliver a copy of the Rework Items List to the ROICC NTR on a monthly basis in accordance with Section C, Part 6.0, of the basic contract.

1.3.2.9 Permits

Fifteen days prior to beginning onsite work, submit draft copies of the following permits required for site activities:

- a. Hot Works Permit; from the Facility Representative, Utilities Division
- b. Excavation Permit; from the Facility Representative, Utilities Division
- c. Outage Permit; from the Facility Representative, Utilities Division

1.3.2.10 Contractor's Closeout Report

Submit upon completion of the project. This report shall include: introduction, summary of action, final Health and Safety Report, summary of record documents, field changes and contract modification, final documents, complete set of field test and laboratory analytical results, complete set of data validation results, documentation of offsite transportation and treatment of materials, QC Summary Report, and final cost data. Report shall also include an evaluation of the system, including quantities of contaminated water treated, contaminants removed, quality of effluent, problems encountered, and solutions implemented.

1.3.3 Forwarding Submittals

After approval of the work plan, and before procurement or fabrication, submit, except as specified otherwise, to the Architect-Engineer, CH2M HILL, 625 Herndon Parkway, Herndon, VA 20170, Attn: Stewart L. Barnes, P.E., the shop drawings and technical data required in the technical sections of this specification. The Architect-Engineer for this project shall review and provide surveillance for the ROICC NTR to determine if Contractor-approved submittals comply with the contract requirements, and shall review and approve for the ROICC NTR those submittals not permitted to be Contractor approved to determine if submittals comply with the contract requirements. At each "Submittal" paragraph in the individual specification sections, a notation "G," following a submittal item, indicates the Architect-Engineer, acting as the agent for the ROICC NTR, is the approving authority for that submittal item. One copy of the transmittal form for submittals shall be forwarded to the ROICC NTR.

Submit to the Commander, LANTNAVFACENGCOM, Code 04A1, 1510 Gilbert Street, Norfolk, VA 23511-2699, submittals for pad-mounted transformers.

1.4 PROJECT DESCRIPTION

This work includes the preparation of a work plan as previously described, as well as the following construction:

- installation of groundwater extraction well pumps
- well vaults
- extraction system piping
- treatment system process equipment
- 75,000-gallon elevated water storage tank
- process power distribution
- process instrumentation and control
- concrete building foundation
- pre-fabricated pre-engineered metal building
- interior building finishes
- interior building electrical and HVAC
- site grading and paving
- utility construction
- site restoration
- related work

After the groundwater extraction and treatment system has been installed and appurtenant facilities and site work is complete, the Contractor shall operate and maintain the system for a period of 365 days. The Contractor shall be responsible for correcting and repairing problems that occur during this 365 day period.

1.5 LOCATION

The work shall be located at the Allegany Ballistics Laboratory, Mineral County, West Virginia, approximately as shown. The exact location shall be as indicated by the ROICC NTR.

1.6 DESCRIPTION OF CONTAMINANTS PRESENT

Chlorinated solvents and inorganic compounds have been detected in groundwater. Site characterization activities conducted for the site groundwater have indicated the following range of contaminant levels present:

- bromodichloromethane ("not detected" to 3 ug/l)
- chloroform ("not detected" to 12 ug/l)
- 1,1-dichloroethane (1,1-DCA) ("not detected" to 920 ug/l)
- 1,2-dichloroethane (1,2-DCA) ("not detected" to 10 ug/l)
- 1,1-dichloroethene (1,1-DCE) ("not detected" to 870 ug/l)
- 1,2-dichloroethene (1,2-DCE) ("not detected" to 12,000 ug/l)
- methylene chloride ("not detected" to 4,800 ug/l)
- tetrachloroethene (PCE) ("not detected" to 98 ug/l)
- toluene ("not detected" to 700 ug/l)
- 1,1,1-trichloroethane (1,1-TCA) ("not detected" to 7,700 ug/l)
- 1,1,2-trichloroethane (1,2-TCA) ("not detected" to 24 ug/l)
- trichloroethane (TCE) ("not detected" to 250,000 ug/l)
- vinyl chloride ("not detected" to 51 ug/l)
- barium (total) ("not detected" to 5,350 ug/l)
- barium (dissolved) ("not detected" to 282 ug/l)

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- manganese (total) ("not detected" to 98,400 ug/l)
- manganese (dissolved) ("not detected" to 30,200 ug/l)

Subsurface soils at the site are not being remediated as part of this contract. Previous site investigations have detected chlorinated solvents, volatile organic compounds, semi-volatile compounds, inorganic compounds, and low levels of dioxins and furans (specific locations). The Contractor shall review all prior investigation reports and data for development of work plans. The above list of contaminants may not be all inclusive.

Boring logs for soil borings performed at the project site, during site characterization activities are shown on the contract drawings.

1.7 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK

The Contractor shall be required to (a) commence work on the Work Plan within 5 calendar days after receiving the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 365 calendar days after receiving the notice to proceed. The time stated for completion shall include final cleanup of the premises and the restoration of the site. The 365-day operational period will begin after the system is complete and initial startup complete.

<u>Project Milestones</u>		<u>Milestone Date</u> <u>(from NTP)</u>
July 7	Work Plan Development Off-Site Work	5
July 7	Work Plan Development On-Site Work	5
Sept 1	Begin Off-Site Construction	65
	Complete Off-Site Construction	245
Mar 1	Begin On-Site Construction	245
May 31	Complete On-Site Construction	335
Jun 1	Begin System Startup	335
Jun 30	Complete System Startup	365
July 1	Begin Operational Period	365
July 98	Complete Operational Area	730

1.8 PROJECT INFORMATION

1.8.1 Contract Drawings

Contract drawings are as follows:

<u>Drawing</u> <u>Number</u>	<u>EFD</u> <u>Number</u>	<u>NAVFAC</u> <u>Number</u>	<u>Title</u>
G-1	461320	4361320	Cover Sheet, Index to Drawings, Vicinity Maps
G-2	461321	4361321	Legends and Abbreviations
G-3	461322	4361322	Legends and Abbreviations
G-4	461323	4361323	Legends and Abbreviations
G-5	461324	4361324	Legends and Abbreviations

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<u>Drawing</u> <u>Number</u>	<u>EFD</u> <u>Number</u>	<u>NAVFAC</u> <u>Number</u>	<u>Title</u>
C-1	461325	4361325	Overall Site Plan
C-2	461326	4361326	Erosion and Sediment Control
C-3	461327	4361327	Erosion and Sediment Control
C-4	461328	4361328	Facility Site Plan
C-5	461329	4361329	Yard Piping Plan
C-6	461330	4361330	Yard Piping Plan
C-7	461331	4361331	Yard Piping Plan
C-8	461332	4361332	Yard Piping Plan
C-9	461333	4361333	Geotechnical Boring Logs
C-10	461334	4361334	Geotechnical Boring Logs
C-11	461335	4361335	Civil Details
C-12	461336	4361336	Civil Details
C-13	461337	4361337	Civil Details
C-14	461338	4361338	Civil Details
C-15	461339	4361339	Civil Details
C-16	461340	4361340	Extraction Well Details
A-1	461341	4361341	Building Floor Plan
A-2	461342	4361342	Building Elevations
A-3	461343	4361343	Building Elevations
A-4	461344	4361344	Plans and Sections
A-5	461345	4361345	Schedules
A-6	461346	4361346	Architectural Details
S-1	461347	4361347	Foundation/Floor Framing Plan
S-2	461348	4361348	Mezzanine Plan and Details
S-3	461349	4361349	Sections and Details
S-4	461350	4361350	Sections and Details
S-5	461351	4361351	Structural Details
S-6	461352	4361352	Structural Details
S-7	461353	4361353	Structural Details
S-8	461354	4361354	Structural Details
S-9	461355	4361355	Structural Details
M-1	461356	4361356	Process Equipment Layout
M-2	461357	4361357	Plumbing Floor Plan
M-3	461358	4361358	HVAC Floor Plan
M-4	461359	4361359	Water Tank Elevations and Details
M-5	461360	4361360	Mechanical Details
M-6	461361	4361361	Mechanical Details
M-7	461362	4361362	HVAC Schedules
M-8	461363	4361363	Piping Layout at Existing Steam Building
E-1	461364	4361364	One-Line Diagram
E-2	461365	4361365	Facility Electrical Plan
E-3	461366	4361366	Power Plan
E-4	461367	4361367	Electrical Site Plan
E-5	461368	4361368	Electrical Vault Plan and Extraction Well Detail
E-6	461369	4361369	Wiring Diagrams and MCC1 Elevation
E-7	461370	4361370	Electrical Details
E-8	461371	4361371	Fixture Schedules
I-1	461372	4361372	Process Flow Diagram
I-2	461373	4361373	Process Mass Balance and Design Criteria
I-3	461374	4361374	Groundwater Extraction and Peroxide Feed
I-4	461375	4361375	Pressure Filters and UV Oxidation Unit
I-5	461376	4361376	Air Stripping and Carbon Unit
I-6	461377	4361377	Elevated Water Storage Tank, Dewatering Aid, and System Water Supply
I-7	461378	4361378	Sludge Decant and Filter Press

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<u>Drawing</u> <u>Number</u>	<u>EFD</u> <u>Number</u>	<u>NAVFAC</u> <u>Number</u>	<u>Title</u>
I-8	461379	4361379	Building Sump and Compressed Air System
I-9	461380	4361380	PICS Block Diagram

1.8.2 Reference Reports

The following reference reports are available for examination in the office of the Code 18 NTR and are intended only to show the existing conditions. The reports and drawings are the property of the Government and shall not be used for any purpose other than that intended by the specification.

Reports

- a. "Interim Remedial Investigation for Allegany Ballistics Laboratory" (Roy F. Weston, Inc., October 1989)
- b. "Remedial Investigation of the Allegany Ballistics Laboratory" (CH2M HILL, January 1996)
- c. "Focused Remedial Investigation of Site 1 at Allegany Ballistics Laboratory Superfund Site" (CH2M HILL, August 1995)
- d. "Site 1 Focused Feasibility Study for Groundwater, Allegany Ballistics Laboratory Superfund Site" (Site 1 Focused Feasibility Study) (CH2M HILL, September 1996)
- e. "Draft Phase I Aquifer Testing at Allegany Ballistics Laboratory Superfund Site" (CH2M HILL, October 1996)
- f. "Draft Phase II Aquifer Testing at Allegany Ballistics Laboratory Superfund Site" (CH2M HILL, January 1997)
- g. "Installation Restoration Program, Site 1 Groundwater, Surface Water, and Sediment at the Allegany Ballistics Laboratory, West Virginia, Proposed Plan" (USEPA, October 1996)
- h. (Memorandum) "Surface Water Discharge Limits for the Site 1 Treatment System at ABL" from Greg Mott/CH2M HILL to WVDEP dated November 19, 1996.
- i. "Record of Decision (ROD) for Site 1 Groundwater at the Allegany Ballistics Laboratory" (United States Navy, February 1997)

1.9 SCHEDULING

The Allegany Ballistics Laboratory Facilities will remain in operation during the entire construction period. The Contractor shall schedule the work as to cause the least amount of interference with facility operations. Work schedules shall be subject to the approval of the ROICC NTR. Permission to interrupt station roads shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption. Notify the ROICC NTR 48 hours prior to starting excavation.

1.9.1 Regular Work Hours

Regular working hours shall be 7:00 am to 5:00 pm, Monday through Friday, excluding Government holidays.

1.9.2 Work Outside Regular Hours

Work outside regular hours requires ROICC NTR and Facility Representative approval. Contractor shall submit an application to the ROICC NTR and Facility Representative, 2 regular working days prior to the scheduled working date, to allow ample time to enable satisfactory arrangements to be made by the Government for inspecting the work in progress. At night, the Contractor shall light the different parts of the work in an approved manner.

1.10 SECURITY REQUIREMENTS

The Contractor shall comply with the general security requirements as stipulated in Section C, Part 2.0, of the basic contract.

1.10.1 Special Security Requirements

Each of the Contractor's employees will be required to check in at Gate 5 at the beginning of each work day and check out at the end of each work day. The Contractor may be denied access to the site when mixing of Class A explosives is scheduled. Information about the mixing schedule can be obtained from Mr. Dave McBride with Aliant-Techsystems, (304) 726-5354 or the Facilities Construction Management Group.

1.11 STORAGE AND TEMPORARY BUILDINGS

1.11.1 Storage in Existing Buildings

Storage in existing buildings shall not be allowed.

1.11.2 Open Site Storage Size and Location

The open site available for storage, laydown, and decontamination shall be confined to the areas indicated on the Drawings, or indicated by the ROICC NTR.

1.11.3 Trailers, Storage, and Temporary Buildings

Locate trailers, storage, and temporary buildings where directed and within the indicated operations area. Trailers or storage buildings shall be permitted where space is available subject to the approval of the ROICC NTR. The trailers or storage buildings shall be suitably painted and kept in a good state of repair. Failure of the Contractor to maintain the trailers or storage buildings in good condition shall be considered sufficient reason to require their removal. Trailers shall be anchored to resist high winds and shall meet applicable State or local standards for anchoring mobile trailers. A sign that conforms to the following requirements and shows the company name, phone number, and emergency phone number, shall be mounted on the trailer or building.

Graphic panel: Aluminum, painted blue; FED-STD-595 25053

Copy: Screen painted or vinyl die-cut, white, Univers 65 u/lc typeface.

1.11.4 Contractor Quality Control Field Office

Provide a trailer of sufficient size for an office trailer work area and floor area for the exclusive use of the quality control (QC)

representative. The office shall have electrical service, heating, air conditioning, and adequate lights and outlets for office use. Also provide room in the same trailer for the QC records. Provide the QC representative with a 4-foot by 8-foot plan table, a standard size office desk and chair, and telephone service. QC records shall be filed in the office and available at all times to the Government. QC field office trailer shall comply with the requirements specified above for other Contractor trailers.

1.12 LOCATION OF UNDERGROUND UTILITIES

Contractor shall comply with the requirements specified in Section C, Part 2.0 of the basic contract, and with requirements specified herein. Obtain facility digging permits prior to the start of excavation activities. Verify elevations of existing underground utilities and obstructions before installing new work closer than the nearest manhole or other structure at which an adjustment can be made.

1.13 UTILITY SERVICES

1.13.1 Temporary Utilities

Contractor shall provide his own utilities.

The Contractor shall contact the Navy Facility Manager in writing to obtain telephone connection. The Contractor shall provide equipment and labor necessary to connect the telephone service to the site. The Contractor shall make arrangements for connections and disconnections and payments.

The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government shall operate the control devices as required for normal conduct of the work. The Contractor shall notify the ROICC NTR, giving 15 days' advance notice when such operation is required.

1.13.2 Utility Cutovers and Interruptions

Make utility cutovers and interruptions outside regular working hours. Conform to procedures specified herein for work outside regular working hours. Ensure that new utilities are complete, except for the connection, before interrupting the existing service.

1.14 RESTRICTIONS ON EQUIPMENT

1.14.1 Radio Transmitter Restrictions

The Contractor shall conform to the restrictions and procedures for the use of radio transmitting equipment, as directed by the ROICC NTR. Do not use transmitters without prior approval.

1.14.2 Electromagnetic Interference Suppression

Electric motors shall comply with MIL-STD-461 relative to radiated and conducted electromagnetic interference. A test for electromagnetic interference will not be required for motors that are identical physically and electrically to those that have previously met the requirements of MIL-STD-461. An electromagnetic interference suppression test will not be required for electric motors without commutation or slip rings having no more than one starting contact and operated at 3600 revolutions per minute or less.

Devices other than electric motors used by the Contractor shall comply with MIL-STD-461 for devices capable of producing radiated or conducted interference.

Conduct tests on electric motors and the Contractor's construction equipment in accordance with MIL-STD-461 and MIL-STD-462. The test location shall be reasonably free from radiated and conducted interference. Furnish the testing equipment, instruments, and personnel for making the tests; a test location; and other necessary facilities.

1.15 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

In conjunction with the Contract Clause "DFARS 252.236-7000, Modification Proposals-Price Breakdown," and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the COE EP 1110-1-8.

1.16 PUBLIC RELEASE OF INFORMATION

Contractor shall comply with requirements stated in Section C, Part 2.0, of the basic contract.

1.17 STORM PROTECTION

Contractor shall conduct storm protection measures in accordance with the requirements of Section C, Part 2.0, of the basic contract, and as specified herein.

1.17.1 Hurricane Condition of Readiness

Unless directed otherwise, comply with:

- a. Condition ONE (sustained winds of 50 knots or greater expected within 12 hours): Secure the jobsite, and leave Government premises.
- b. Condition TWO (sustained winds of 50 knots or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear missile hazards and loose equipment from general base areas. Contact ROICC NTR for weather and condition of readiness (COR) updates and completion of required actions.
- c. Condition THREE (sustained winds of 50 knots or greater expected within 48 hours): Maintain Condition FOUR requirements and commence securing operations necessary for Condition ONE which cannot be completed within 18 hours. Cease routine activities which might interfere with securing operations. Commence securing and stow gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to Condition TWO and continue action as necessary to attain Condition THREE readiness. Contact ROICC NTR for weather and COR updates and completion of required actions.
- d. Condition FOUR (sustained winds of 50 knots or greater expected

within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 4 feet high. Remove debris, trash, or objects that could become missile hazards. Contact ROICC NTR for COR updates and completion of required actions.

1.18 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the delivery order, environmental protection as defined in Section C, Part 4.0, of the basic contract, and as specified herein.

1.18.1 Fire Protection

Comply with COE EM-385-1-1, NFPA 241, and activity fire regulations. Post the activity fire poster in conspicuous locations and at telephones in construction trailers.

1.19 PRECONSTRUCTION CONFERENCE

After approval of the Work Plan, but prior to commencement of any work at the site, Contractor shall meet with the ROICC NTR to discuss and develop a mutual understanding relative to the administration of the HASP, preparation and submission of submittals, scheduling, programming, and prosecution of the work. Major subcontractors who will be engaged in the work shall also attend.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CLEANING UP

During the progress of the remediation, the work area and adjacent areas shall be kept clean and free of rubbish, surplus materials, and unneeded construction equipment. No material or debris shall be allowed to flow or wash into watercourses, ditches, gutters, drains, or pipes. Upon completion of the work, sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish, and construction facilities from the site.

-- End of Section --

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01115	SD-09 Reports														
			Work Plan	1.2.1.3													
			SD-18 Records														
			As-Built records	1.3.2.1	G												
			Environmental Conditions Report	1.3.2.2	G												
			Status reports	1.3.2.3	G												
			Network Analysis Diagram	1.3.2.3	G												
			QC meeting minutes	1.3.2.4	G												
			Test Results Summary Report	1.3.2.5	G												
			Contractor Production Report	1.3.2.6	G												
			QC Report	1.3.2.7	G												
			Rework Items List	1.3.2.8	G												
			Permits	1.3.2.9	G												
			Contractor's Closeout Report	1.3.2.10	G												
		01561	SD-02 Manufacturer's Catalog Data														
			Filter Barriers	2.1													
			Sediment Fence	2.2													
			Dust Suppressors	2.4													
			Erosion Control Matting	2.6													
			SD-08 Statements														
			Construction Sequence Schedule	1.3.2.1	G												
		02315	SD-12 Field Test Reports														
			Fill and backfill	3.10.2.1													
			Structural fill	3.10.2.2													
			Density tests	3.10.2.4													
		02510	SD-02 Manufacturer's Catalog Data														

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		02510	Water distribution main	2.1													
			Water service line	2.2													
			Hydrants	1.3													
			Corporation stops	2.2.2.1													
			Valve boxes	1.3													
			SD-06 Instructions														
			Installation	3.1.1													
		02530	SD-02 Manufacturer's Catalog Data														
			Pipeline materials	2.1													
			SD-04 Drawings														
			Precast concrete manhole	1.3													
			Metal items	2.2.2													
		02582	SD-02 Manufacturer's Catalog Data														
			Precast concrete structures	2.1.3.1	G												
			Precast concrete structures	3.1.3.1	G												
			Frames and covers	2.1.1.2	G												
			Frames and covers	2.1.3.2	G												
			Sealing material	2.1.3.1	G												
			Cable racks, arms and insulators	2.1.2	G												
			SD-04 Drawings														
			Precast manhole and handhole	1.3.2.1	G												
			Pulling-in irons	3.1.3.3	G												
		02630	SD-02 Manufacturer's Catalog Data														
			Concrete piping	2.1.1													
			SD-04 Drawings														
			Precast concrete structures	1.2													

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		02741	SD-02 Manufacturer's Catalog Data														
			Precast car stops	1.2													
			SD-08 Statements														
			mix delivery record	1.2.2.1													
			Asphalt concrete	2.1													
			SD-11 Factory Test Reports														
			Trial batch	1.2.3.1													
			Mix design	1.2.3.2													
			SD-12 Field Test Reports														
			Asphalt concrete	2.1													
			Density	3.3.2.2													
			Density	3.3.2.3													
			Thickness	3.3.2.2													
			Thickness	3.3.2.3													
			Straightedge test	3.3.2.2													
		03200	SD-04 Drawings														
			Reinforcing steel	1.2.1.1													
		03300	SD-02 Manufacturer's Catalog Data														
			Materials for curing concrete	2.2.7													
			Vapor barrier	2.2.6													
			SD-05 Design Data														
			mix design	2.1.1													
			SD-08 Statements														
			Pumping concrete	1.3.3.1													
			SD-10 Test Reports														
			Concrete mix design	1.3.4.1													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04200	SD-02 Manufacturer's Catalog Data														
			Masonry accessories	2.4													
			Reinforcement	2.4.1													
			Pre-mixed mortar	2.2.2													
			Flashing	1.2													
			SD-04 Drawings														
			Reinforcing steel	1.2.2.1													
			SD-05 Design Data														
			Pre-mixed mortar	2.2.2													
			SD-06 Instructions														
			Masonry cement	2.2.1.3													
			SD-11 Factory Test Reports														
			Unit strength method	2.5.1													
			Mortar properties	2.2.1													
			Grout	2.3													
			Grout	3.2.2													
			SD-12 Field Test Reports														
			Grout strength	2.3													
			Grout strength	3.2.2													
			Mortar strength and properties	3.2.1													
			SD-13 Certificates														
			Concrete masonry units	2.1.1													
			SD-14 Samples														
			Masonry units	2.1	G												
		05500	SD-02 Manufacturer's Catalog Data														
			Cover plates and frames	2.3													

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05500	Floor gratings	2.4													
			Handrails	2.6													
			Ladders	2.7													
			Aluminum stairs	2.10													
			Structural steel door frames	2.11													
			SD-04 Drawings														
			aluminum stairs	2.10													
			structural steel door frames	2.11													
			Cover plates and frames	2.3													
			Floor gratings	2.4													
			Handrails	2.6													
			Ladders	2.7													
			angles and plates	2.8													
		07214	SD-02 Manufacturer's Catalog Data														
			Block or board insulation	2.1													
			Pressure sensitive tape	2.3													
			Accessories	2.4													
			SD-06 Instructions														
			Block or Board Insulation	2.1													
			Adhesive	2.4.1													
		07920	SD-02 Manufacturer's Catalog Data														
			Sealants	2.1													
			Primers	2.2													
			Bond breakers	2.3													
			Backstops	2.4													
		08110	SD-02 Manufacturer's Catalog Data														

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		08110	Doors	2.1													
			Door Frames	2.4													
			Window Frames	2.4													
			Fasteners and Accessories	1.2													
			Weatherstripping	2.6													
			SD-04 Drawings														
			Doors	2.1													
			Door Frames	2.4													
			Window Frames	2.4													
			Accessories	2.2													
			Weatherstripping	2.6													
			SD-07 Schedules														
			Doors	2.1													
			Door Frames	2.4													
			Window Frame	2.4													
			Air infiltration	1.2.4.1													
			Water infiltration	1.2.4.1													
		08331	SD-02 Manufacturer's Catalog Data														
			Rolling service doors	2.1													
			Motors	2.3.2													
			Controls	2.3.3													
			SD-04 Drawings														
			Rolling service doors	2.1	G												
			SD-06 Instructions														
			Rolling service doors	2.1													
			SD-19 Operation and Maintenance														

Manuals

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08331	Rolling service doors	2.1													
		08710	SD-02 Manufacturer's Catalog Data														
			Hardware items	2.3	G												
			SD-06 Instructions														
			Installation	3.1													
			SD-07 Schedules														
			Hardware schedule	1.2.3.1													
			Keying system	2.3.5													
			SD-18 Records														
			Key bitting	1.2.4.1													
			SD-19 Operation and Maintenance														
			Manuals														
			Hardware Schedule	1.2.3.1													
		08800	SD-06 Instructions														
			Setting and sealing materials	2.3													
			Glass setting	3.2													
		09250	SD-02 Manufacturer's Catalog Data														
			Accessories	2.1.6													
		09900	SD-02 Manufacturer's Catalog Data														
			Coating	1.2.1.1	G												
			Sealant	1.2.1.1													
			SD-06 Instructions														
			Application instructions	1.2													
			Manufacturer's material safety data	1.2													
			sheets														
			SD-07 Schedules														

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09900	Piping identification	3.7													
			SD-08 Statements														
			Evidence of acceptable variation	1.2.4.1	G												
			SD-14 Samples														
			Color	1.8	G												
		10400	SD-02 Manufacturer's Catalog Data														
			post and panel signs	2.5													
			plaque signs	2.6													
			SD-04 Drawings														
			post and panel signs	2.5													
			plaque signs	2.6													
			SD-14 Samples														
			post and panel signs	2.5	G												
			plaque signs	2.6	G G												
		10800	SD-02 Manufacturer's Catalog Data														
			Manufactured units	2.3													
			SD-13 Certificates														
			Manufactured units	2.3													
			SD-14 Samples														
			Manufactured units	2.3													
		11305	SD-02 Manufacturer's Catalog Data														
			Extraction well submersible pumps	1.3.1.1	G												
			Submersible pump motors	1.3													
			Well vault hatch	1.3	G												
			Well cap	1.3													
			SD-04 Drawings														

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		11305	Layout drawings	1.3.2.1	G												
			Wiring diagrams	1.3.2.2	G												
			SD-06 Instructions														
			Manufacturer's installation instructions	1.3.3.1	G												
			Spare parts and special tools	1.3.3.2													
			SD-08 Statements														
			Design calculations	1.3.4.1	G												
			Manufacturer's Certificate of Proper Installation	1.3.4.2	G												
		11311	SD-02 Manufacturer's Catalog Data														
			Fiberglass packaged flow metering equipment	2.1.1													
			SD-04 Drawings														
			Metering Station Shop drawings	1.2.2.1	G												
			SD-06 Instructions														
			Manufacturer's installation instructions	1.2.3.1	G												
			Spare parts and special tools	1.2.3.2													
		11312	SD-02 Manufacturer's Catalog Data														
			Packaged lift station	1.3.1													
			SD-04 Drawings														
			Packaged lift station	1.3.1													
			Equipment foundations	3.1.1													
			SD-08 Statements														

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		11312	Foundation approval certificate	3.1.1													
			SD-18 Records														
			Posted operating instructions	3.1.3													
			SD-19 Operation and Maintenance Manuals														
			Packaged lift station	1.3.1													
		11325	SD-02 Manufacturer's Catalog Data														
			UV/Oxidation System	1.3.1.1	G												
			SD-04 Drawings														
			Layout drawings	1.3.2.1	G												
			Wiring diagrams	1.3.2.2	G												
			Electrical and instrumentation details	1.3.2.3	G												
			SD-06 Instructions														
			Manufacturer's instructions	1.3.3.1	G												
			Spare parts and special tools	1.3.3.2													
			SD-08 Statements														
			Manufacturer's Certificate of Proper Installation	1.3.4.1													
			Treatability Testing Plan	1.3.4.2	G												
			Peroxide Vendor Statement of Qualifications	1.3.4.3													
			Statement of Zero Air Emissions	1.3.4.4													
			SD-11 Factory Test Reports														
			Factory Functional Test Report	1.3													
			Factory Treatability Test Report	1.3													

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		11325	SD-12 Field Test Reports														
			Field Performance Testing	3.2													
			SD-19 Operation and Maintenance Manuals														
			UV/Peroxide Oxidation System	1.3	G												
		11350	SD-02 Manufacturer's Catalog Data														
			Liquid-Phase Carbon System	1.3.1.1	G												
			SD-04 Drawings														
			Layout drawings	1.3.2.1	G												
			SD-06 Instructions														
			Manufacturer's instructions	1.3.3.1	G												
			SD-08 Statements														
			Design calculations	1.3.4.1	G												
			Manufacturer's Certificate of Proper Installation	1.3.4.2													
			Carbon Testing	3.2													
			SD-19 Operation and Maintenance Manuals														
			GAC system	2.1	G												
		11370	SD-02 Manufacturer's Catalog Data														
			Top-entering mixer	1.3.1.1	G												
			SD-04 Drawings														
			Mechanical and electrical drawings	1.3.2.1	G												
			SD-06 Instructions														
			Manufacturer's instructions	1.3.3.1	G												
			Spare parts and special tools	1.3.3.2													

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		11370	SD-08 Statements														
			Design calculations	1.3.4.1	G												
			Manufacturer's Certificate of Proper	1.3.4.2													
			Installation														
			SD-12 Field Test Reports														
			Functional Testing	1.3													
			SD-19 Operation and Maintenance														
			Manuals														
			Mixer and accessories	1.3	G												
		11371	SD-04 Drawings														
			Layout drawings	1.3.2.1	G												
			Wiring diagrams	1.3.2.2	G												
			Electrical details	1.3.2.3	G												
			Instrumentation details	1.3.2.4	G												
			SD-06 Instructions														
			Manufacturer's instructions	1.3.3.1	G												
			Spare parts and special tools	1.3.3.2													
			SD-08 Statements														
			Design calculations	1.3.4.1	G												
			Manufacturer's Certificate of Proper	1.3.4.2													
			Installation														
			SD-12 Field Test Reports														
			Field Testing	1.3													
			SD-19 Operation and Maintenance														
			Manuals														
			Air compressor system	2.1													

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		11390	SD-02 Manufacturer's Catalog Data														
			Vertical Submersible Pumps	1.3	G G												
			SD-04 Drawings														
			Layout drawings	1.3.2.1	G												
			Wiring diagrams	1.3.2.2	G												
			Electrical details	1.3.2.3	G												
			Instrumentation details	1.3.2.4	G												
			SD-06 Instructions														
			Manufacturer's instructions	1.3.3.1	G												
			Spare parts and special tools	1.3.3.2													
			SD-08 Statements														
			Design calculations	1.3.4.1	G												
		13000	SD-02 Manufacturer's Catalog Data														
			Flow Element and Transmitter,	2.1	G												
			Electromagnetic FE/FIT- 2-1														
			Flow Element and Indicator,	2.2	G												
			Propeller FE/FI-3-1														
			Flow Element, Impeller FE-1-2-Y (1	2.3	G												
			through 34), FE-8-1														
			Flow Monitor/Totalizer Transmitter	2.4	G												
			FIT-1-2-Y (1 through 34), FIT-8-1														
			Flow Switch, Paddle FS-12-1	2.5	G												
			Level Switch, Float Type with	2.6	G												
			Integral Switch LSH-9-1														

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		13000	Level Element, Pressure Type	2.7	G												
			Submersible LE 1-2-Y(Y=1 THRU 34)														
			Level Transmitter, Electronic LIT 1-2-Y(Y=1 THRU 34)	2.8	G												
			Level element and Transmitter, Ultrasonic LE/LIT-10-1	2.9	G												
			Pressure Differential Transmitter, Electronic PE/PIT-8-1	2.10	G												
			Pressure Gauge PI-1-2-Y (Y=1 THRU 34), PI-7, PI-9	2.11	G												
			Pressure Transmitter, Electronic PE/PIT-2-1	2.12	G												
			Pressure Seal, Diaphragm	2.13	G												
			Warning light, Strobe type	2.14	G												
			Horn	2.15	G												
			Autodialer	2.16	G												
			SD-04 Drawings														
			Wiring Diagrams	1.2	G												
			Mounting details	1.2	G												
		13112	SD-02 Manufacturer's Catalog Data														
			Rectifiers	2.3													
			Impressed current anodes	2.1													
			reference electrodes	2.4													
			SD-04 Drawings														
			Rectifier installation	3.1.3.1													

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		13112	Anode installation	3.1.1													
			Wiring and schematic diagram	2.3.5													
			Anode junction boxes	1.3													
			SD-05 Design Data														
			Cathodic protection design	1.5	G												
			SD-08 Statements														
			corrosion engineer	1.4	G												
			SD-12 Field Test Reports														
			Initial field testing	1.3	G												
			Warranty period testing	3.4.1.6	G												
			Final field testing	3.4.1.7	G												
			Ground resistance testing	1.3	G												
			SD-19 Operation and Maintenance														
			Manuals														
			Cathodic Protection System	3.4.1.6													
		13121	SD-02 Manufacturer's Catalog Data														
			materials	2.1													
			SD-03 Manufacturer's Standard														
			Color Charts														
			Factory color finish	2.10.2													
			SD-04 Drawings														
			Preengineered building	1.5.3.1	G												
			anchor bolts	1.5.4.1													
			SD-05 Design Data														
			Building	1.5.4.1	G												
			Foundation loads	1.2.3	G												

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		13121	Anchor bolts	1.5.4.1	G												
			Purlins and girts	1.5	G												
			Bracing	1.5	G												
			SD-11 Factory Test Reports														
			Factory Color Finish	2.10.2													
			Insulation	2.8													
			SD-19 Operation and Maintenance Manuals														
			Preengineered Building	1.5.3.1													
		13209	SD-02 Manufacturer's Catalog Data														
			Tanks	2.2.1													
			Coating systems for welded tanks	2.2.4													
			SD-04 Drawings														
			Foundations	3.1.1.1													
			Obstruction lighting	2.4													
			Elevated steel tank	1.2													
			Grounding systems	2.5													
			SD-06 Instructions														
			Coating systems for welded tanks	2.2.4													
			SD-08 Statements														
			AWWA D100	1.2													
			AWWA D103	1.2													
			SSPC SP 5	1.2													
			SSPC SP 10	1.2													
			SSPC VIS 1	1.2													
			SD-10 Test Reports														

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		13209	steel tank	2.1													
			structural steel	1.2													
			Abrasive for blasting	2.2.8													
			SD-19 Operation and Maintenance														
			Manuals														
			Water storage tank	1.3													
		13281	SD-02 Manufacturer's Catalog Data														
			Local exhaust equipment	1.4	G												
			Vacuums	3.1.4	G												
			Respirators	3.1.1.1	G												
			Pressure differential automatic	1.4	G												
			recording instrument														
			Amended water	1.2.2	G												
			Glovebags	3.1.6	G												
			Material Safety Data Sheets	1.3.8	G												
			(MSDS) for all materials														
			Encapsulants	2.1	G												
			SD-08 Statements														
			Asbestos hazard abatement plan	1.4.2.1	G												
			Testing laboratory	1.4.2.2	G												
			Private qualified person	1.4.2.3	G												
			documentation														
			Landfill approval	1.4.2.4	G												
			Employee training	1.4.2.5	G												
			Medical certification	1.4.2.6	G												
			Waste shipment records	1.4.2.4	G												

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		13281	Respiratory Protection Program	1.4.2.7	G												
			Hazardous waste manifest	1.4.2.4	G												
			SD-12 Field Test Reports														
			Air sampling results	1.4.3.1	G												
			Pressure differential recordings for local exhaust system	1.4.3.2	G												
			Asbestos disposal quantity report	3.3.3.2	G												
			Encapsulation test patches	1.4	G												
			Clearance sampling	3.2.4.3	G												
			SD-13 Certificates														
			Vacuums	3.1.4	G												
			Water filtration equipment	3.1.2.3	G												
			Ventilation systems	3.1.4	G												
			equipment used to contain airborne asbestos fibers	3.1	G												
			encapsulants	2.1	G												
			SD-18 Records														
			Notifications	1.4.5.1	G												
			Rental equipment	1.4.5.2	G												
			Respirator program records	1.4.5.3	G												
			Permits	1.3.4	G												
			Protective clothing decontamination quality control records	1.4.5.4	G												
			Protective clothing decontamination facility notification	1.4.5.5	G												
		13390	SD-01 Data														

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		13390	Programmable Controller	1.3.1.1													
			SD-13 Certificates														
			Manufacturer's Certificate of Proper Installation	1.3.3.1													
		13402	SD-02 Manufacturer's Catalog Data														
			ACP-1	1.4	G												
			Personal Computer	1.4	G												
			Software	1.4	G												
			UPS	1.4	G												
			Printer	1.4	G												
			SD-04 Drawings														
			Panel Construction Drawings	1.4.2.1	G												
			Panel Wiring Diagrams	1.4.2.2	G												
			Interconnecting Wiring Diagrams	1.4.2.3	G												
			Panel	1.4.2.1													
			Panel	1.4.2.2													
			SD-19 Operation and Maintenance														
			Manuals														
			ACP-1	1.4	G												
			Personal computers	1.4	G												
			Uninterrupted Power Source	1.4	G												
			Printer	1.4													
		15060	SD-02 Manufacturer's Catalog Data														
			Pipe schedules	3.14	G												
			Piping support systems	3.7	G												
			Double-walled HDPE pipe systems	1.2	G												

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		15060	SD-04 Drawings														
			layout drawings	1.2.2.1	G												
			SD-08 Statements														
			Design calculations	1.2.3.1													
			Resin certification	1.2.3.2													
			SD-12 Field Test Reports														
			pressure and leakage testing	3.12.1													
		15080	SD-02 Manufacturer's Catalog Data														
			Accessory materials	1.3													
			Adhesives, sealants, and coating compounds	1.3													
			Piping insulation	2.1													
			Piping insulation	2.1.1													
			Piping insulation jackets	2.1													
			Piping insulation jackets	2.1.1													
		15081	SD-06 Instructions														
			field-applied insulation	1.2													
		15183	SD-02 Manufacturer's Catalog Data														
			Unit heaters	2.2													
			Valves	2.1.7													
			Valve operating mechanism	1.3													
			Steam meters	1.3													
			Traps	2.1.11.3													
			Strainers	2.1.11.4													
			Expansion joints	2.1.9													
			Pipe anchors	2.1.11.7													

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		15183	Pipe guides	2.1.11.6													
			Instrumentation	2.1.10													
			SD-06 Instructions														
			Unit heaters	2.2													
			SD-08 Statements														
			Welding procedure	1.3.3.1													
			Welder's Performance Qualification	1.3.3.2													
			Record														
			List of welders and welder's symbols	1.3.3.2													
			SD-10 Test Reports														
			Steam piping	1.3													
			Copper tubing	2.1.2.1													
			Valves	2.1.7													
			Expansion joints	2.1.9													
			Instrumentation	2.1.10													
			Pipe and pipe system	2.1													
			Unit heaters	2.2													
		15400	SD-02 Manufacturer's Catalog Data														
			Pipe and fittings	2.1													
			Valves	2.2.2													
			Plumbing fixtures	2.4													
			Water heaters	2.6													
			Pipe hangers and supports	2.3.4													
			Water hammer arresters	2.2.4													
			Drains	2.1.4													

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CONTRACT NO.
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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		15400	Backflow preventers	2.2.5													
			Backflow preventers	3.5.2.3													
			Electric drinking fountains	2.4.4													
			SD-10 Test Reports														
			Backflow Preventers Test Report	2.2.5													
			Backflow Preventers Test Report	3.5.2.3													
			SD-19 Operation and Maintenance														
			Manuals														
			Water heaters	2.6													
			Electric drinking fountains	2.4.4													
		15720	SD-02 Manufacturer's Catalog Data														
			Fans	2.1													
			SD-10 Test Reports														
			Corrosion protection	1.4													
			SD-12 Field Test Reports														
			Preliminary tests	3.3.2													
			Air handling and distribution	1.3													
			equipment tests														
			SD-19 Operation and Maintenance														
			Manuals														
			Fans	2.1													
		15730	SD-02 Manufacturer's Catalog Data														
			Heat pumps	2.1													
			Filters	1.3													
			Thermostats	1.3													
			Refrigerant piping and accessories	2.3													

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		15730	SD-04 Drawings														
			Field-assembled refrigerant piping	2.3.1													
			Control system wiring diagrams	1.3.2.1													
			SD-06 Instructions														
			Heat pumps	2.1													
			Filters	1.3													
			Thermostats	1.3													
			Refrigerant piping and accessories	2.3													
			SD-11 Factory Test Reports														
			Salt-spray tests	2.5.1													
			SD-12 Field Test Reports														
			Start-up and initial operational tests	3.8.3													
			SD-18 Records														
			Posted operating instructions	1.3.6.1													
			SD-19 Operation and Maintenance														
			Manuals														
			Heat pumps	2.1													
			Filters	1.3													
			Thermostats	1.3													
		15810	SD-02 Manufacturer's Catalog Data														
			Dampers	2.7													
			Louvers	2.7													
			Bird screens	2.7.2.1													
			Diffusers, registers, and grilles	1.4													
			Metal ducts	2.1													
			SD-07 Schedules														

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		15810	Registers	2.3													
		15950	SD-08 Statements														
			Independent TAB agency	1.4.1.1													
			personnel qualifications														
			Design review report	1.4.1.2													
			Pre-field TAB engineering report	1.4.1.3													
			Advanced notice for Season 1 TAB	1.4.1.4													
			field work														
			Check out list for Season 1	1.4.1.5													
			Advanced notice for Season 2 TAB	1.4.1.4													
			field work														
			Check out list for Season 2	1.4.1.5													
			SD-12 Field Test Reports														
			Certified TAB report for Season 1	1.4.2.1													
			Certified TAB report for Season 2	1.4.2.1													
		16081	SD-08 Statements														
			Qualifications	1.3.1.1	G												
			Acceptance test and inspections	1.3.1.2	G												
			procedure														
			SD-12 Field Test Reports														
			Acceptance tests and inspections	3.1	G												
		16272	SD-02 Manufacturer's Catalog Data														
			Pad-mounted transformers	1.3.5.1	G												
			Pad-mounted transformers	2.2	G												
			SD-04 Drawings														
			Pad-mounted transformer drawings	1.3.2.1	G												

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		16272	SD-11 Factory Test Reports														
			design tests	1.3	G												
			routine and other tests	1.3	G												
			SD-12 Field Test Reports														
			acceptance checks and tests	3.5.1	G												
			Ground resistance test reports	1.3.4.1	G												
			SD-19 Operation and Maintenance Manuals														
			Pad-mounted transformer(s)	1.3.5.1	G												
			Pad-mounted transformer(s)	2.2	G												
		16303	SD-02 Manufacturer's Catalog Data														
			Medium voltage cable	1.4.4.2	G												
			Medium voltage cable	2.1.6	G												
			Medium voltage cable	2.1.7	G												
			Medium voltage cable	2.1.8	G												
			Medium voltage cable terminations	2.1.6	G												
			Medium voltage cable terminations	2.1.7	G												
			SD-04 Drawings														
			Precast manhole	1.4.2.1	G												
			Pulling-in irons	3.1.8.1	G												
			Frames and covers	2.1.12.3	G												
			SD-08 Statements														
			Cable splicer/terminator	1.4.3.1	G												
			SD-09 Reports														
			Arc-proofing test	1.4.4.1	G												

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		16303	Medium voltage cable qualification and production tests	1.4.4.2	G												
			Medium voltage cable qualification and production tests	2.1.6	G												
			SD-12 Field Test Reports														
			Field Acceptance Checks and Tests	3.2.1	G												
		16402	SD-02 Manufacturer's Catalog Data														
			Receptacles	2.9	G												
			Circuit breakers	2.10.2	G												
			Switches	2.8	G												
			Transformers	2.14	G												
			Enclosed circuit breakers	1.3	G												
			Motor controllers	2.16	G												
			Combination motor controllers	2.18.3	G												
			Firestopping materials	1.3	G												
			Manual motor starters	2.17	G												
			Heat Trace	1.3	G												
			Metering	1.3	G												
			Adjustable frequency drives	1.3	G												
			Mini power centers	1.3	G												
			Disconnect switches	1.3	G												
			SD-04 Drawings														
			Panelboards	2.10	G												
			Transformers	2.14	G												
			Motor control centers	2.18	G												

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		16402	Wireways	1.3	G												
			Adjustable frequency drives	1.3	G												
			Mini power centers	1.3	G												
			SD-08 Statements														
			Fuses	2.13	G												
			SD-12 Field Test Reports														
			600-volt wiring test	3.2.2	G												
			Grounding system test	3.2.5	G												
			Transformer tests	3.2.3	G												
			SD-19 Operation and Maintenance														
			Manuals														
			Electrical Systems	1.3.5.1													
		16510	SD-02 Manufacturer's Catalog Data														
			Fluorescent lighting fixtures	2.1	G												
			Fluorescent lamp electronic ballasts	2.1.1	G												
			Fluorescent lamps	2.1.2	G												
			Metal-halide lamps	2.1.4	G												
			Exit signs	2.9	G												
			Emergency lighting equipment	2.10	G												
			Obstruction light	1.4	G												
			Lighting contactor	2.7	G												
			SD-12 Field Test Reports														
			Operating test	3.2													
			SD-18 Records														
			Information card	1.4.3.1	G												

SECTION 01561

EROSION AND SEDIMENT CONTROL

10/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-1909

Fertilizer

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A185

1990 (Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM D3786

1987 Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method

ASTM D4632

1991 Grab Breaking Load and Elongation of Geotextiles

ASTM D4751

1993 Determining Apparent Opening Size of a Geotextile

1.2 DESCRIPTION OF WORK

The work includes the provision of temporary and permanent erosion control measures to prevent the pollution of air, water, and land within the project limits and in areas outside the project limits where work is accomplished in conjunction with the project.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Filter Barriers
- b. Sediment Fence
- c. Dust Suppressors
- d. Erosion Control Matting

1.3.2 SD-08, Statements

- a. Construction Sequence Schedule G

1.3.2.1 Construction Sequence Schedule

Submit a Contractor furnished construction work sequence schedule a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on site erosion and off site sedimentation. Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and pollution.

PART 2 PRODUCTS

2.1 FILTER BARRIERS (Max 18 inches high)

2.1.1 LANTDIV STANDARD FILTER BARRIERS

2.1.1.1 Posts

One inch by 2 inch seasoned wood posts, 1-1/2 inch diameter seasoned wood posts or 1.0 pound per linear foot steel posts. Posts shall be minimum 3 feet long.

2.1.1.2 Filter Fabric

A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

- | | |
|---|------------|
| a. Minimum grab tensile strength (ASTM D4632) | 100 pounds |
| b. Minimum grab elongation (ASTM D4632) | 25 percent |
| c. Minimum mullen burst strength (ASTM D3786) | 210 psi |
| d. E.O.S. (ASTM D4751) | 20-100 |

2.1.1.3 Standard Catalog Product

A manufacturer's standard catalog product for a preassembled filter barrier may be provided in lieu of the indicated filter barrier except that the filter fabric shall be as specified, and the height of the structure shall be as indicated.

2.2 SEDIMENT FENCE

2.2.1 LANTDIV STANDARD SEDIMENT FENCE

2.2.1.1 Posts

4 inch by 4 inch wood posts, minimum 3 inch diameter wood, or 1.33 pound per linear foot steel posts. Posts shall be minimum 6 feet long.

2.2.1.2 Wire Fabric

ASTM A185, 6 by 6, minimum 12-1/2 gage.

2.2.1.3 Filter Fabric

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

- a. Minimum grab tensile strength (ASTM D4632) 100 pounds
- b. Minimum grab elongation (ASTM D4632) 25 percent
- c. Minimum mullen burst strength (ASTM D3786) 210 psi
- d. E.O.S. (ASTM D4751) 20-100

2.2.1.4 Standard Catalog Product

A manufacturer's standard catalog product for a preassembled sediment fence may be provided in lieu of the indicated sediment fence, except that the filter fabric shall be as specified, and the height of the structure shall be as indicated.

2.3 CONSTRUCTION ENTRANCE

2.3.1 LANTDIV STANDARD CONSTRUCTION ENTRANCE

2.3.1.1 Aggregate

ASTM D448, Size No. 3.

2.3.1.2 Filter Fabric

A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

- a. Minimum grab tensile strength (ASTM D4632) 200 pounds
- b. Minimum grab elongation (ASTM D4632) 220 percent
at failure
- c. Minimum mullen burst strength (ASTM D3786) 430 psi
- d. E.O.S. (ASTM D4751) 40-80

2.4 DUST SUPPRESSORS

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.5 TEMPORARY SEEDING

2.5.1 LANTDIV Standard Temporary Seeding

2.5.1.1 Seed

Provide State certified seed of the latest season's crop. Seed shall be a mixture of Hybrid Fescue, Red Top and Bermuda.

2.5.1.2 Fertilizer

CID A-A-1909, with 10 percent nitrogen, 20 percent available phosphoric

acid, and 10 percent potash.

2.5.1.3 Mulch

Hay or straw. Provide in an air dried condition for placement with commercial mulch blowing equipment.

2.6 EROSION CONTROL MATTING

2.6.1 Straw Matting

A machine produced straw mat with a minimum thickness of 1/2 inch +/- 1/8 inch. The straw shall be evenly distributed throughout the mat to provide a minimum average dry weight of .70 pounds per square yard. The topside of the mat shall be covered with a 3/8 inch biodegradable plastic mesh, with the mesh attached to the straw by a knitting process using biodegradable thread.

PART 3 EXECUTION

3.1 CONSTRUCTION SEQUENCE SCHEDULE

Stabilize areas for construction access immediately with gravel. Install principal sediment basins and traps before any major site grading takes place. Provide additional sediment traps, sediment fences and filter barriers as grading progresses. Provide inlet and outlet protection at the ends of new drainage systems. Stabilize graded and disturbed areas immediately after grading. Permanent stabilization shall be provided immediately on areas that have been final graded. Temporary seeding and mulching shall be provided on disturbed areas as specified in the paragraph titled "Temporary Seeding." Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and pollution. Remove temporary erosion control measures at the end of construction and provide permanent seeding.

3.2 FILTER BARRIERS AND SEDIMENT FENCES

Install posts at the spacing indicated, and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Filter barrier height shall be 15 to 18 inches. Sediment fence height shall be approximately 34 inches. Do not attach filter fabric to existing tree. Secure filter fabric to the post and wire fabric using staples, tie wire, or hog rings. Imbed the filter fabric into the ground. Splice filter fabric at support pole using a 6 inch overlap and securely seal. Top of the filter fabric shall have a 1 inch tuck or a reinforced top end section.

3.3 CONSTRUCTION ENTRANCE

Provide as indicated, a minimum of 6 inches thick, at points of vehicular ingress and egress on the construction site. Construction entrances shall be cleared and grubbed, and then excavated a minimum of 3 inches prior to placement of the filter fabric and aggregate. The aggregate shall be placed in a manner that will prevent damage and movement of the fabric. Place fabric in one piece, where possible. Overlap fabric joints a minimum of 12 inches.

3.4 DUST SUPPRESSORS

Immediately dampen the surface before calcium chloride application. Apply dust suppressors on unsurfaced base, subbase and other unsurfaced travel ways. Apply calcium chloride at the rate of 1.0 to 1.25 pounds per square yard of surface for pellets for the initial application. For subsequent applications of calcium chloride, application rates may be approximately 75 percent of initial application rates. Do not apply when raining or the moisture conditions exceed that required for proper application. Apply other dust suppressors in accordance with manufacturers instructions. Protect treated surfaces from traffic for a minimum of 2 hours after treatment. Repeat application of dust suppressors as required to control dust emissions.

3.5 TEMPORARY SEEDING

3.5.1 Time Restrictions

Within 48 hours after attaining the grading increment specified herein, provide seed, fertilizer, mulch and water on graded areas when any of the following conditions occur:

- a. Grading operations stop for an anticipated duration of 30 days or more.
- b. Provide on the slopes of cuts and fill slopes for every 5 foot increment of vertical height of the cut or fill.
- c. When it is impossible or impractical to bring an area to finish grade so that permanent seeding operations can be performed without serious disturbance from additional grading.
- d. Grading operations for a specific area are completed and the seeding seasons specified for permanent seeding is more than 30 days away.
- e. When an immediate cover is required to minimize erosion, or when erosion has occurred.
- f. Provide on erosion control devices constructed using soil materials.

3.5.2 Seeding Requirements

3.5.2.1 LANTDIV Standard Seeding Requirements

Loosen subgrade to a minimum depth of 4 inches. Uniformly apply the seed, fertilizer, and mulch at the specified application rates. Roll the seeded area after applying seed and fertilizer. Do not seed or fertilize when the Contracting Officer determines conditions are unfavorable. Provide fertilizer at the rate of 1000 pounds per acre. Spread mulch at the rate of 1.5 tons per acre and anchor by crimping mulch with a disc. Provide water on a regular basis to promote turf growth. Provide seed type and quantity (pounds per acre) as follows:

Feb 1 - Apr 15

SEED TYPE

Nov 16 - Jan 31

Oct 16 - Nov 15

Apr 16 - Oct 15

Hybrid Fescue

200

200

Red Top

6

6

6

Bermuda

45 (unhulled)

45 (unhulled)

100 (hulled)

3.5.2.2 Permanent Seeding

Temporary seeding shall be removed, and permanent seeding shall be provided during the specified planting season.

3.6 MAINTENANCE AND INSPECTION

Inspect erosion control devices after each rainfall and daily during prolonged rainfall. Remove sediment deposits after each rainfall or when sediment reaches approximately one-half the barrier height. Immediately repair damaged erosion control devices and damaged areas around and underneath the devices. Maintain erosion control devices to assure continued performance of their intended function. Modify the erosion control plan as required to control problem areas noticed after each inspection. Modifications shall be approved by the Contracting Officer.

3.7 CLEAN UP

At the completion of the job, or when directed or approved by the Contracting Officer, temporary erosion control devices shall be removed. Erosion control devices and areas immediately adjacent to the device shall be filled (where applicable), shaped to drain and to blend into the surrounding contours, and provided with permanent seeding. Erosion control devices may remain in place when approved by the Contracting Officer.

-- End of Section --

SECTION 01781

OPERATION AND MAINTENANCE DATA
09/96

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data/Manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section C, Part 7 of the Basic Contract.

1.1.1 Quantity

Submit five sets of the supplier/manufacturers' O&M information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M Data/Manuals are required are listed in the technical sections which specifies those particular items.

1.1.2 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.3 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." For each product, system, or component piece of equipment requiring submission of O&M Data, submit the Data Package specified in the individual technical section.

1.1.4 Delivery

Submit O&M Data Manuals to the Contracting Officer for review and acceptance as specified in Section 01115, "General Paragraphs (Remedial Action Contracts);" submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

- a. In the event the Contractor fails to deliver O&M Data/Manuals within the time limits set forth above, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data/Manuals are associated.

1.1.5 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Postshutdown Procedures

Provide narrative description for each operating procedure including control sequence for each.

1.2.1.4 Normal Operations

Provide narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.

1.2.1.7 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications;

- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
- c. A lubrication schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Parts data may cover more than one model or series of equipment. components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.2.6.3 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.6.4 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M Data Packages specified in individual technical sections.
The required information for each O&M Data Package is as follows:

1.3.1 Data Package 1

- a. Safety precautions
- b. Maintenance and repair procedures
- c. Warranty information
- d. Contractor information
- e. Parts list (for assembled items)

1.3.2 Data Package 2

- a. Safety precautions
- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan and schedule
- f. Maintenance and repair procedures
- g. Removal and replacement instructions
- h. Spare parts and supply list
- i. Parts identification
- j. Warranty information
- k. Contractor information

1.3.3 Data Package 3

- a. Safety precautions
- b. Normal operations
- c. Emergency operations
- d. Environmental conditions
- e. Lubrication data
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring diagrams and control diagrams

- i. Maintenance and repair procedures
- j. Removal and replacement instructions
- k. Spare parts and supply list
- l. Parts identification
- m. Warranty information
- n. Testing equipment and special tool information
- o. Contractor information

1.3.4 Data Package 4

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and postshutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Corrective maintenance man-hours
- p. Parts identification
- q. Warranty information
- r. Personnel training requirements
- s. Testing equipment and special tool information
- t. Contractor information

1.3.5 Data Package 5

- a. Safety precautions

- b. Operator prestart
- c. Start-up, shutdown, and post shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- g. Troubleshooting guides and diagnostic techniques
- h. Wiring and control diagrams
- i. Maintenance and repair procedures
- j. Spare parts and supply list
- k. Testing equipments and special tools
- l. Warranty information
- m. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01783

ENVIRONMENTAL FACILITY USER MANUALS

05/96

PART 1 GENERAL

1.1 GENERAL MANUAL REQUIREMENTS

The work covered by this section includes provision of a detailed Environmental Facility User manual (hereafter called "Manual") which contains pertinent information needed for efficient, economical, safe, life cycle operation and maintenance (O&M) of the Groundwater Remediation System, Site 1, Northern Riverside Waste Disposal Area, and appurtenant buildings and systems provided by this contract. This Manual shall include the specified O&M information for all buildings and remediation systems provided by this contract. The Contractor shall do the work specified in this specification section.

The Manual shall be fully developed from the basic O&M data submittals made by the Contractor for Section 01781, "Operation and Maintenance Data". The user manual shall be developed, beginning with the basic O&M data obtained for each item of equipment, into a facility-wide instruction manual with system-by-system subgroups.

1.2 MANUAL DESCRIPTION

Provide an environmental facility user Manual which contains detailed, as-built information that describes the efficient, economical and safe operation, maintenance and repair of the subject facility. These Manuals are to be factual, concise, comprehensive and written so that they can be easily understood by maintenance personnel. Descriptive matter and theory must include technical details that are essential for a comprehensive understanding of the operation, maintenance and repair of the system.

The environmental facility user manual provider shall ensure that changes to systems and equipment, made during construction, are reflected in the Manuals. The words "system", "systems" or "equipment", when used in this section, refers to as-built systems and equipment.

1.3 MANUAL ORGANIZATION

The Manual shall be prepared in three parts. PART I shall contain the system description and overview of how the system is to operate, system flow diagrams, normal operation procedures, emergency operating procedures, emergency contact information, medical emergency contact and directions, and safety instructions. PART II shall contain all preventative maintenance schedule information, and repair information. PART III shall contain all product and manufacturers data on all equipment in the remediation system.

1.4 SOURCES OF DATA

Approved submittals such as Operation and Maintenance (O&M) Data, Product Data and Shop Drawings, furnished by the construction Contractor, are the primary sources of information needed to prepare the Manual. For the O&M Data, the construction specification technical sections specify O&M Data

requirements by assigning Data Packages to each specific piece of equipment or component. The requirements of each Data Package are listed in Section 01781, "Operation and Maintenance Data."

1.5 SUBMITTAL REQUIREMENTS

Submit in accordance with Section C, Part 7 of the Basic Contract.

- a. Concept Submittal G
- b. Preliminary Submittal G
- c. Prefinal Submittal G
- d. Final Submittal

1.5.1 Concept Submittal

Provide two hard copies. The purpose of this submittal is to present, for approval, an overall plan to be followed during the ongoing preparation of the Manual. This will include but not be limited to providing the following information:

1. Identify by name all systems that will be addressed in the manual.
2. Provide the format and table of the contents of the manual and include the following:
 - (a) Sample spring post loose-leaf binder. Show a typical title as it will appear on the Manual front face and also on the spine of the binder.
 - (b) Proposed divider format with the sample divider and completed tab.
 - (c) Samples showing the quality of paper and quality of reproduction proposed.
 - (d) Select one system of moderate complexity and partially develop the various operational and maintenance aspects of the system. This development should have sufficient depth to clearly demonstrate the arrangement and level of detail proposed for all systems that will be included.

1.5.2 Preliminary Submittal

Provide two hard copies. The manuals are to be provided at 50 percent or more completion. The preliminary submittal shall show the detailed development of each section of the manual. One system shall be essentially complete with regard to the four sections required under this section's paragraph entitled "Part II-Operation, Maintenance, and Repair Information". As a minimum, the four sections of the remaining systems shall be completed to the greatest extent possible using available construction contractor data. Inexpensive binders or post type fasteners are acceptable for this submittal.

The complete preliminary Manual and review comments will be returned to the Contractor for preparation of the Prefinal submittal.

1.5.3 Prefinal Submittal

Provide two hard copies. The manual at 100 percent completion. Therefore, it should contain all the required information that is available at the time of submission. Approved binders are required for this submittal. The Prefinal submittal shall include a copy of the Preliminary submittal review comments along with the Contractor's response to each item.

Review comments on the prefinal submittal may be provided to the Contractor at various times after submission and up to 21 days before due date of the final Manual. These comments will address recommendations and problems encountered during ongoing operation and maintenance of the facility. The comments from the Navy's Technical Representative (NTR) will be returned to the Contractor no later than 21 days before the due date of the final Manual.

1.5.4 Final Submittal

Submit two hard copies, and two CD-ROM copies. Final submittal must address all previous review comments. Prefinal review comments may include problems discovered during Manual review, Site validation, and Facility start up. The comments will be provided to the Contractor at various times before and after the prefinal submittal. If the comments require only minor corrections the hard copies of the Manual will not be returned and the Contractor shall correct the Manual by submitting correction sheets and directions on how to make the corrections. The final Manual submittal shall include a copy of the Prefinal submittal review comments along with a response to each item.

1.5.5 Submittal Schedule

Submit to Commander, LANTNAVFACENGCOM, Code 18225, Attn: Mr. James F. Harris, 1510 Gilbert Street, Norfolk, VA 23511-2699. Submit one copy of the transmittal letter to the ROICC NTR.

- a. Concept Submittal: 45 calendar days after notice to proceed, submit two hard copies to the ROICC NTR for the purpose of the user's review and approval, and one hard copy to LANTNAVFAC ENGCOM Code 18225 for the Code 18 NTR's review and approval.
- b. Preliminary Submittal: 90 calendar days prior to contract completion date, submit one hard copy to the ROICC NTR for the purpose of the user's review and approval, and one hard copy to LANTNAVFACENGCOM Code 18225 for the Code 18 NTR's review and approval.
- c. Prefinal submittal: 1 calendar day prior to commencement of the operational period, submit two hard copies to the ROICC NTR for the purpose of the user's review and approval.
- d. Final submittal: At the end of the operational period, submit the required copies with the updates and supplements as required by the previous submittals to ROICC NTR for the user's review and approval.

PART 2 PRODUCTS

2.1 DESCRIPTION OF WORK

2.1.1 PART I - Facility Information

(1) General Facility and Treatment/Remediation Systems Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems listed in PART II and any special building features, i.e., monorails, hoists. Photographs shall be included to depict the overall facility appearance and the actual installed system/equipment. Photographs and schematic diagrams shall be marked up and labeled to show key operating components. The manual shall discuss the major treatment units and processes in the system. A discussion of evaluation procedures for the overall system performance as it pertains to effectiveness of the remediation. The description shall physically trace the flow through the system and contain information on design efficiency.

(2) Basis of Design

Include the Basis of Design that shows the basic design scope of work, assumptions and the original intentions of the designer of record.

(3) Safety Hazards

List all residual hazards identified in the Requirements Hazard Analysis as prepared by the designer of record. Recommended safeguards should also be provided for each identified hazard.

(4) Site and Floor Plans

Floor plans shall only include room numbers, type or function of spaces, and overall facility dimensions. Construction instructions, references, frame numbers, etc., are not required.

(5) Utility Connection and Cutoff Plans

Provide utility site plans and floor plans that indicate the main interior and exterior connection and cutoff points for all utilities. Plans shall contain enough information to enable someone unfamiliar with the facility to locate the connection/cutoff points. The plans should indicate the room number, panel number, circuit breaker, valve number, etc., of each connection/cutoff point; as well as which system, portion of a system, or area is controlled by that connection/cutoff point.

(6) Extended Warranty Information

List all products and equipment, including components and sub components, which are warranted in excess of one year and provide a cross reference to the written warranties which are included in PART III. The list shall indicate the specification section applicable to the product or equipment, the duration of the warranty, the start date and the end date of the warranty, and the point of contact for fulfillment of the warranty. Also, list or reference all specific operation and/or maintenance procedures which are required to keep the warranty valid.

(7) Equipment Inventory

Provide an equipment inventory that includes item descriptions, locations, model numbers, manufacturer and supplier names and addresses. The

equipment inventory shall be limited to major components such as those shown on design equipment schedules.

(8) Floor Coverings

Provide a tabular listing of each room (including hallways and common spaces) indicating the room number, type of space and the type and area of floor covering used in that room. Indicate the total area for each type of space and floor covering.

(9) Wall Surfaces

For each room number, indicate the type and area of wall surfaces used in that room. Also, identify the total area of each type of interior wall surface in the facility.

(10) Ceiling Surfaces

For each room number, indicate the type and area of ceiling surface used in that room. Also, identify the total area of each type of ceiling surface in the facility.

(11) Light Fixtures

Identify the total number and types of light fixtures and size of bulbs/tubes required.

(12) Roofing

Identify the total area of each type of roof surface/system. Provide the name of the roofing product/system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers. For each type of roof, provide a recommended inspection, maintenance and repair schedule which details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

(13) Supply Inventory Requirements

Provide a list of spare parts, fuels, lubricants, etc. required for maintenance and repair to ensure continued operation without unreasonable delays. Give special consideration to facilities at remote locations. List parts and supplies having long lead times.

(14) Manufacturers, Suppliers and Contractors/Subcontractors

Provide a list of names, addresses, and telephone numbers of manufacturers, suppliers, and contractors/subcontractors for installed equipment.

(15) As-built Drawing List

Provide a list of the as-built drawings. Include drawing number and title and indicate where the drawings and specifications will be physically filed.

(16) Training Requirements

Provide a list of recommended training related to the O&M of each installed system which is available from the manufacturer or other source. Provide the name, address, and phone number of point of c

ontact. The training requirements shall pertain only to systems listed in PART II.

(17) Permits/Consent Orders and Copies

Provide a listing of the equipment that requires special operation, reporting, testing, analysis or inspection to comply with federal and related state/local environmental laws and their respective implementing regulations, statutes, or policies. For each system/equipment, describe the requirements for environmental operation, reporting, testing, analysis and inspection. Provide an overview discussion of the applicable remediation and discharge Permit(s)/Consent Order(s) and provide copies of each.

(18) Sampling and Laboratory Testing

Explanation of representative sampling and the methods of sample collection and schedule for sample collection. A description and an exact location of each sampling point shall be included and should be supplemented with photographs as required. This section shall include a list of tests to be performed and their purpose. Laboratory tests and frequency shall be conducted in accordance with applicable permits. A summary table shall be presented which outlines samples to be collected, analyses to be performed, analytical method(s), and frequency of sample collection.

(19) Medical Emergency Contact and Directions

The manual shall describe in detail the policies and procedures in the event of a medical, fire, or police emergency. The manual shall provide a discussion in detail of directions to nearby medical, fire, and police facilities. A map shall also be included which clearly illustrates the preferred direction to nearby medical facilities. Emergency telephone numbers shall be provided in a summary table and identified in some manner which allows for quick locating in the manual.

2.1.2 PART II - Operation, Maintenance and Repair Information

Provide the information required under PART II using a systems approach. Using this approach, consider the entire system, i.e., the interfaces of equipment, connections and material flow within the system. Provide the specified information on the following systems:

1. Mechanical Heating System
2. Ventilation System
3. Central Mechanical Systems
4. Exhaust Systems
5. Treatment/Remediation /Recovery Systems

Throughout PART II, Notes, Cautions and Warnings shall be used to emphasize important and critical instructions and procedures. Notes, cautions and warnings shall immediately precede the applicable instructions or procedures and shall be selected as follows:

Note: Concerns an operating procedure or practice which should be highlighted.

Caution: Concerns an operating procedure or practice which, if not strictly observed, could result in damage to, or destruction of equipment.

Warning: Concerns an operating procedure or practice which, if not properly observed, could result in a hazard to health, injury to personnel, or loss of life.

1. Operation

a. System Description

Provide a detailed discussion of the system composition and operation. Descriptive matter and theory shall include technical details that are essential for an understanding of the system.

b. Start-Up and Shutdown Procedures

Provide step by step instructions to bring systems from static to operational configurations and from operating to shutdown status.

c. Normal Operating Instructions

Provide a discussion of the normal operation and control of the system. The discussion shall include operating norms, i.e., temperatures, pressures, flow rates expected at each zone or phase of the system. The discussion shall be supplemented with control/wiring diagrams and data.

d. System Flow Diagrams

Provide a flow diagram indicating system liquid, air (do not include ductwork) or gas flow during normal operations. The diagram shall integrate all system components. A compilation of non-integrated, flow diagrams for the individual system components is not acceptable. The diagram shall integrate all system components with each component being represented by a unique and readily discernible identification pattern or color.

e. Diagrammatic Plans

Provide floor plans indicating the location of equipment and configuration of the system installation. Include the configuration of associated piping or wiring. Floor plans shall subordinate structural features to utility features.

f. Emergency Operating Instructions

Provide emergency operating procedures in the event of equipment malfunctions. Provide shutdown instructions for fires, explosions, spills, or other contingencies. Provide emergency procedures in a step by step instructional format. Appropriate personnel to be contacted in the event of an emergency operating condition shall be listed in tabular form with their addresses, physical location, Email address (if applicable), telephone, and fax numbers.

g. Environmental Considerations

Provide a listing of the equipment which requires special operation, reporting, testing, analysis or inspection to comply with federal and related state/local environmental laws and their respective implementing regulations, statutes, or policies.

Examples are discharge permit testing, hazardous material/waste usage and

storage documentation, and air pollution control devices. For each system/equipment, describe the requirements for environmental operation, reporting, testing, analysis and inspection.

h. Operator Servicing Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

i. Safety Instructions

Provide a list of all personnel hazards and equipment safety precautions including recommended safeguards. The manual shall inform personnel of known hazards, preventative measures, and emergency procedures applicable to the system. This shall include, but in no way be limited to the following: electrical hazards; mechanical equipment hazards; explosion hazards; fire hazards; chemical hazards; health hazards; confined space procedures; IDLH hazards; and safety equipment. The manual shall contain a list of safety references of interest to operating personnel.

j. Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

k. Operating Log

Provide forms, samples, and instructions for keeping necessary operating records.

2. Preventive Maintenance

a. Preventive Maintenance Plan and Schedule

Provide a Preventive Maintenance (PM) plan using manufacturer's recommendations and sound engineering practice. The Plan shall cover all major pieces of equipment. The Plan shall provide a check sheet which details maintenance tasks and associated frequencies. Also provide an annual schedule indicating when maintenance tasks should be performed such that work is spread as evenly as possible throughout the year.

b. Preventive Maintenance Procedures

Provide a Work Order/Task Card for each individual maintenance task identified on the PM plan and Schedule. The PM procedures shall detail required skill level, number of personnel needed, special tools needed, safety instructions and precautions, and estimated time required to complete the task.

c. Preventive Maintenance Log

Provide a tabular form for recording the accomplishment of PM. Log must record date PM was performed, findings, action taken, and other data necessary to provide a good historical record of PM activities.

d. Lubrication Schedule

Provide a lubrication schedule indicating types/grades and capacities of lubricants for specific temperature ranges and applications.

3. Repair

a. Troubleshooting Guides and Diagnostic Techniques

Provide step by step procedures for isolating the cause of system malfunctions. The procedures shall clearly state the indications or symptoms of trouble; the sequential instructions, including checks and tests to be performed and conditions to be sought, to determine the cause; and remedial measures to bring the equipment and system to operating condition. Identify special test equipment required to perform the procedures. The troubleshooting guide shall start at the system level and be brought to a level where the manufacturer's troubleshooting procedure for equipment and components can be referenced. Refer to the manufacturer's data for the maintenance and repair instructions required to restore equipment to proper operating standards. References must be specific as to location within the manufacturers manual(s). Refer to the manufacturer's data for the instructions on the removal and replacement of equipment components. References must be specific as to location within the manufacturers manual(s). Provide a tabular form for the recording of the accomplishment of repair work. The form shall include a description of work performed, parts used, time required to complete the work, and other data necessary to provide a good historical record of repair activities.

b. Repair Procedures

Refer to the manufacturer's data for the maintenance and repair instructions required to restore equipment to proper operating standards. References must be specific as to location within the Manuals.

c. Removal and Replacement Instructions

Refer to the manufacturer's data for the instructions on the removal and replacement of equipment components. References must be specific as to location within the Manuals.

d. Repair Log

Provide a tabular form for the recording of the accomplishment of repair work. The form shall include a description of work performed, parts used, time required to complete the work, and other data necessary to provide a good historical record of repair activities.

e. Plant Records and Reporting

The requirements for the operators worksheet, logs, and laboratory analysis results (daily, weekly, monthly, and others as required) shall be presented and discussed in detail. An example of each form shall be included in the Manual. A discussion of the policies and procedures for filing the worksheets, logs, and laboratory analysis results and with whom these reports shall be presented.

4. Manufacturer's Data

a. Operation and Maintenance Data

Include the O&M Data Package information provided by the construction contractor per Section 01781 of the specification. This information shall be incorporated into the preparation of each system discussion under the

Operation, PM and Repair sections of the Manual.

b. Manufacturer's Equipment Information

Provide drawings, illustrations and technical data furnished by the manufacturer for the equipment and system components. The information shall be organized and indexed for easy reference.

c. As-Builts

The manual shall contain as-built drawings stamped "as-built" and dated for the entire remediation system. Drawings shall be clean and free of extraneous markings.

2.1.3 PART III - Product Data

2.1.3.1 Record of Material and Equipment

This section shall provide a record of materials and equipment used in the facility construction. This record shall include all materials and equipment for which manufacturer's data submittals were made in accordance with the construction specifications; specifically, information related to Division 2 and Division 8 through 16.

Catalog cuts, data sheets, test reports and warranty sheets are examples of appropriate sources for inclusion. Include shop drawings based on specific relevance to O&M of the facility or system (except those discussed in PART II.) The manual shall also contain a spare parts inventory. The inventory shall list the minimum and maximum quantities of spare parts, the equipment in which they are used, their storage location and other pertinent information. Extraneous data, such as transmittal sheets, certifications, welder qualifications, contractor qualifications and certificates of compliance, shall not be included in the Manual.

If submittals, such as catalog cuts and manufacturer's data sheets, are composed such that information on several part or model numbers is shown, the installed material should be highlighted or otherwise noted, and the extraneous sheets removed from the submittal package.

2.1.3.2 Warranties

Provide written copies of extended equipment warranties.

2.2 Manual Format

2.2.1 Hard Copies

2.2.1.1 Binders

The Manuals shall be bound in durable, hard cover, water and grease resistant binders, which hold 8.5" X 11" sheets.

PART I shall be bound in a white, springpost, loose leaf binder of one inch or 1-1/2 inch capacity. PART II shall be bound in blue, springpost, loose leaf binders of three inch capacity. PART III shall be bound in red, springpost, loose leaf binders of three inch capacity.

Binders shall have clear pockets located on the front and on the spine that

hold printed sheets identifying the project title, project number, location, construction contract number, prepared for, prepared by, and subtitles of the parts and their subsections included in that binder.

PART II binders shall be further identified with the specific systems included in that binder. More than one system may be included in a single binder provided that all sections of each system are included in that binder. Each binder is a single volume.

Each volume within each part shall be consecutively numbered, i.e., PART I (Facility Information) Vol 1 of 1, PART II (Operation, Maintenance and Repair Information) Vol 2 of 3, and PART III (Product Data) Vol 1 of 4.

2.2.1.2 Pages, Dividers and Tabs

Pages in the Manuals shall be of high quality paper. The dividers shall be heavy duty paper with plastic reinforced holes and integrated tabs. For PART I, tabs shall identify the major items of facility information. For PART II, tabs shall identify the system title, the different sections under each system, and the major topics under each section. For PART III, tabs shall show the Division 2 through 16 title, the specification section number with keywords to identify the section title, and major equipment groupings i.e. air strippers, pumps, carbon tanks. Tabs shall also be provided to identify O&M data within each specification section.

2.2.1.3 Oversized Sheets

Submittals, instruction sheets, drawings, etc., larger than 8-1/2" X 11", but not exceeding 11" X 17", shall be inserted into the binders as single fold-out sheets. Submittals or drawings exceeding 11" X 17", which cannot be reduced, may be inserted in labeled, clear plastic pockets.

2.2.1.4 Preface

The Preface Sheet containing the information shown on Exhibit 01783-1 shall be inserted in front of each volume of the Manuals. Exhibit 01783-1 is included at the end of this section.

2.2.1.5 Table of Contents

A separate Master Table of Contents shall be provided for the entire set of Facility User Manual (PARTS I, II, and III) and placed at the beginning of each volume after the Preface sheet. A specific Table of Contents shall be provided for Facility Information in PART I, for each System in PART II and for each Division and Section of the construction specification in PART III.

2.2.2 CD-ROM Manual

Provide a final Manual set in a CD-ROM format. The CD-ROM shall be an exact replica of the hard copy. The CD shall be developed using off-the-shelf technology. The CD shall be in the stand alone format with hypertext linking capabilities. The CD shall be OCR (Optical Character Recognition) capable. The CD shall be indexed in such a way as to search for keywords in the text. CD jackets must be labeled with project title.

PART 3 EXECUTION

Not used.

-- End of Section --

PREFACE

INTRODUCTION

The Facilities User Manual concept was developed to help activities operate and maintain selected facilities. The Manual provides a comprehensive, organized library of data of as-built materials, equipment and systems and should be used as the first step in solving operation, maintenance or repair problems. We hope you will find that these Manuals will save you time and expense.

Your comments or suggestions are welcomed and should be forwarded to Commander, LANTNAVFACENGCOM, 1510 Gilbert Street, Norfolk, Virginia 23511-2699, Attn: Code 4061. Telephone (804)322-4301, FAX (804)322-4415.

CONTENTS

The Manual consists of three parts.

PART I contains Facility and Remediation Systems Information. This portion of the Manual contains useful information for the preparation of maintenance service contracts and for the owners of the facility and remediation system.

PART II contains Operation Maintenance and Repair Information for selected systems requiring operation, maintenance, and repair procedures (specifically for the remediation system installed.) Each system discussed in PART II covers Operation, Preventive Maintenance, Repair and Manufacturer's Data. Under each section, the Manuals may provide extensive additional information such as normal and emergency operating procedures, flow diagrams, PM requirements, spare parts, troubleshooting, repair procedures, warranty provisions.

PART III contains Product Data. This portion of the Manual consists mainly of construction contractor submittals for as-built materials and equipment such as Manufacturer's Catalog Data, Shop Drawings, test data, and Operation and Maintenance Data not included in PART II. PART III is organized by divisions and sections corresponding to the divisions and sections of the construction specifications. For example, if you wanted to find information about interior electrical wiring, you would look under "Electrical", and then under Section 16402, "Interior Wiring Systems."

UPDATING

The Manual should reflect the facility's and remediation system's existing components. Therefore, you must continuously update the Manual. When equipment is replaced, add pertinent new information to each Manual set. Be sure to update all sections of the Manual that reference the replaced item. Purge all information on the replaced item to prevent future confusion.

SECTION 02222

EXCAVATION AND REMOVAL OF CONTAMINATED SOIL AND WATER

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

The provisions of Section 01115, "General Paragraphs (Remedial Action Contract)," Section 01561, "Erosion and Sediment Control," and Section 02315, "Excavation and Fill," apply to this section.

1.2 DEFINITIONS

1.2.1 Contaminated Soil and Water

Soil and water encountered during construction activities, including but not limited to, excavation activities for piping, well vaults and appurtenant structures. Suspected contamination in the approximate area of potentially contaminated soils delineated in the Drawings include VOCs, SVOCs, inorganic contaminants, and explosives.

1.3 WORK INCLUDED

Excavation and removal of contaminated soil and water for this project is expected to be limited. Remedial cleanup work for surface soils in this area will be conducted in the future, once limits and cleanup levels have been established.

The work under this contract is focused on groundwater remediation. Soils removed from excavations will be temporarily staged adjacent to the excavation and backfilled in the same area.

The Contractor shall coordinate construction to minimize inflow of surface water due to rainfall and runoff. Phasing work in multiple areas and similar management practices may be required to keep progress of the work on schedule.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Methods

The Contractor shall not begin work until all notifications are performed and all required submittals are approved. The Contractor shall perform soil and water removal activities without damage or contamination of adjacent areas.

3.1.2 Monitoring

The Contractor shall be responsible for any required air, soil, or water monitoring in conformance with their submitted Site Health and Safety Plan.

Monitoring in the Health and Safety Plan shall include surveys prior to and during construction to determine the presence of possible explosives in the area of construction.

3.2 CONTAMINATED SOILS

3.2.1 Excavation

The Contractor shall manage all soils encountered during construction activities in the suspected contaminated areas as contaminated soils. Methods and equipment used to remove soils shall result in minimal disturbance beyond the excavation limits.

3.2.2 Backfill

In areas of suspected soil contamination, soils will be temporarily staged adjacent to the location of excavation. After excavation, all soil will be replaced in the original excavation as fill above the pipe zone. Adequate provisions for site restoration and free surface drainage will be made.

3.3 CONTAMINATED WATER

3.3.1 Removal

- a. The Contractor shall manage all water encountered during construction activities in the suspected contaminated areas as contaminated water. Best management practices shall be used to minimize runoff of surface water from the upgradient side of the excavation areas.
- b. In the event that stormwater does enter and fill excavations, the Contractor will be required to stop work in the area until excess water evaporates, or seeps into the ground.

3.4 EQUIPMENT DECONTAMINATION

The Contractor shall decontaminate all equipment which comes into contact with contaminated soil and water. The Contractor shall limit, as much as practical, contacting equipment parts with contaminated soil and water. Decontamination cleaning shall be accomplished, as much as possible, using dry methods.

-- End of Section --

SECTION 02315

EXCAVATION AND FILL

06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 136	(1995; Rev. A) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1992) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 2321	(1989) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1995) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909

Fertilizer

CORPS OF ENGINEERS (COE)

COE EM-385-1-1

(1992) Safety and Health Requirements
Manual

STATE HIGHWAY SPECIFICATION (SHS)

SHS-MDOT

(1993) Maryland Department of
Transportation, State Highway
Administration, Standard Specifications
for Construction and Materials

1.2 DEFINITIONS

1.2.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.2 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.3 Cohesive Materials

Materials ASTM D 2487 classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

1.2.4 Cohesionless Materials

Materials ASTM D 2487 classified as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

1.2.5 Building Influence Area

The influence area of the building is defined as the outer dimension of the building foundation plus 5 feet 0 inches.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7.0 of the Basic Contract.

1.3.1 SD-12, Field Test Reports

- a. Fill and backfill test
- b. Structural fill test
- c. Density tests

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.
- e. Hard materials and rock are not expected to be encountered in the excavations. For more information, see boring logs shown on the drawings.
- f. Blasting will not be permitted. Remove material in an approved manner.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, GC, SW, SP, SM, SC, CL and ML.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Structural Fill

ASTM D 2487, conforming to SHS-MDOT CR-6, with a maximum liquid limit and plasticity index of 40 and 10, respectively. The gradation shall be 100 percent passing 1.5 inch sieve, 25 to 55 percent passing No. 4 sieve, 15 to 45 percent passing No. 10 sieve, and 0 to 12 percent passing No. 200 sieve.

2.2 GRANULAR FILL

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Soil Materials."

2.3 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.4.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, and brush within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.1.2 Stripping

Strip existing topsoil to a depth of 4 inches without contamination by subsoil material. Stockpile topsoil separately from other excavated material and locate convenient to finish grading area.

3.1.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.1.3.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After grading to subgrade elevation, proof roll the existing subgrade of the building with six passes of a dump truck loaded with 6 cubic meters of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the truck shall be in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer to a depth of 6 inches and replaced with select material.

3.1.4 Building Site Preparation

Perform building site preparation as indicated.

3.2 PROTECTION

3.2.1 Protection Systems

Provide shoring, bracing, and sheeting in accordance with COE EM-385-1-1.

3.2.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.2.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Provide temporary ditches, swales, and other drainage

features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

3.2.2.2 Dewatering

Provide as specified in Section 02222, "Excavation and Removal of Contaminated Soil and Water. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.

3.2.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.2.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Refill with backfill and fill material and compact to 95 percent of ASTM D 698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with structural fill and compact to 95 percent of ASTM D 1557 maximum density.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill overexcavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement.

3.4 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.4.1 Common Fill Placement

Provide for general site. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.4.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where structural fill is provided. Place in 6 inch lifts. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.3 Structural Fill Placement

Provide under porous fill of building footprint and foundation structures not pile supported. Place in 6 inch lifts. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.4.4 Granular Fill Placement

Provide under floor slab on a compacted subgrade. Place in 4 inch lifts.

3.4.5 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one footover pipe outside structures and paved areas.

3.4.5.1 Bedding Requirements

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

- a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.5 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape

12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.6 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.7 COMPACTION

Expressed as a percentage of maximum density. Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required.

3.7.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the structure to 95 percent of ASTM D 1557 at a moisture content within 2 percent of optimum moisture content.

3.7.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557 at a moisture content within 2 percent of optimum moisture content. Compact fill and backfill material and porous fill to 95 percent of ASTM D 1557 at a moisture content within 2 percent of optimum moisture content..

3.7.3 Granular Fill

Compact with two passes of a hand operated, plate type vibratory compactor.

3.7.4 Adjacent Area

Compact areas within 5 feet of structures to 95 percent of ASTM D 1557 at a moisture content within 2 percent of optimum moisture content.

3.7.5 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D 1557. Compact fill and backfill materials to 95 percent of ASTM D 1557.

3.8 FINISH OPERATIONS

3.8.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8.2 Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded

finish earth surfaces and areas disturbed by the Contractor. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.8.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

Take the number and size of samples required to perform the following tests.

3.10.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.10.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.2 Structural Fill Test

Test structural fill in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 or ASTM D 1557 for moisture density relations, as applicable.

3.10.2.3 Granular Fill Test

Test granular fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.10.2.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

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and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut.

-- End of Section --

SECTION 02510

WATER DISTRIBUTION

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.22 (1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 42 (1993) Seamless Copper Pipe, Standard Sizes

ASTM B 61 (1993) Steam or Valve Bronze Castings

ASTM B 62 (1993) Composition Bronze or Ounce Metal Castings

ASTM B 88 (1995) Seamless Copper Water Tube

ASTM C 94 (1994) Ready-Mixed Concrete

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4 (1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids

AWWA C111/A21.11 (1990; Erratum 1991) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C115/A21.15 (1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

ANSI/AWWA C151/A21.51	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153/A21.53	(1994) Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,000 mm Through 1,600 mm), for Water Service
AWWA C500	(1993) Metal-Seated Gate Valves for Water Supply Service
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	(1992) Disinfecting Water Mains
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA M9	(1979) Concrete Pressure Pipe

FEDERAL SPECIFICATIONS (FS)

FS WW-P-460	(Rev. D) Pipe Fittings; Brass or Bronze (Threaded) Classes 125 and 250 Pound
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
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UNDERWRITERS LABORATORIES INC. (UL)

UL 262	(1994) Gate Valves for Fire-Protection Service
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1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 12 inch diameter pipe sizes of ductile-iron pipe. Also provide water main accessories, gate valves and check valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as less than 4 inch lines from water distribution main to building service at a point approximately 5 feet from building. Water service lines shall be copper tubing. Provide water service line appurtenances as specified and where indicated.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Water distribution main piping, fittings, joints, valves, and coupling
- b. Water service line piping, fittings, joints, valves, and coupling
- c. Hydrants
- d. Corporation stops
- e. Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

1.3.2 SD-06, Instructions

- a. Installation procedures for water piping

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

- a. Pipe and Fittings: Pipe ANSI/AWWA C151/A21.51, pressure class conforming to Tables 51.1 and 51.3 for Type 4 trench, 150 psi maximum working pressure. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints. Provide mechanical joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

(5) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, FS WW-P-460, 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88, Type K. Fittings for solder-type joint, ANSI B16.18 or ASME/ANSI B16.22; fittings for compression-type joint, ASME/ANSI B16.26, flared tube type.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME/ANSI B16.26.

2.2.2.2 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Where multiple gooseneck connections are required for an individual service, goosenecks shall be connected to the service line through a suitable approved brass or bronze branch connection; the total clear area of the branches shall be at least equal to the clear area of the service line. Length of goosenecks shall be in accordance with standard practice.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 18 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

- c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill."

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

With connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the

applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

- b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) metal harness for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24, except as otherwise indicated.

3.1.2.2 Installation of Valves and Hydrants

- a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the point indicated; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

3.1.4 Disinfection

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. Repair of welded joints to stop leakage shall be done by welding only. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), flanged joints, and screwed joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

-- End of Section --

SECTION 02530

SANITARY SEWERAGE

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM C 94 | (1994) Ready-Mixed Concrete |
| ASTM C 443 | (1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |
| ASTM C 923 | (1994) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals |
| ASTM C 972 | (1987) Preparing Test Specimens from Basic Refractory Gunning Products by Pressing |
| ASTM D 412 | (1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension |
| ASTM D 624 | (1991) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers |
| ASTM D 4101 | (1995) Propylene Plastic Injection and Extrusion Materials |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- | | |
|-----------------------|---|
| AWWA C105/A21.5 | (1993) Polyethylene Encasement for Ductile - Iron Pipe Systems |
| AWWA C111/A21.11 | (1990; Erratum 1991) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| ANSI/AWWA C151/A21.51 | (1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids |

AWWA C600

(1993) Installation of Ductile-Iron Water
Mains and Their Appurtenances

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27

Fixed Ladders

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621

(Rev. E) Frames, Covers, Gratings, Steps,
Sump and Catch Basin, Manhole

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains 2 inch lines of ductile-iron pipe. Provide building connections 3 inch lines of cast iron soil pipe.

Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

Gravity sanitary drain pipe shall be as specified in Section 15400, "Plumbing Systems."

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of ductile iron pressure pipe.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Pipeline materials including joints, fittings, and couplings

Submit manufacturer's standard drawings or catalog cuts.

1.3.2 SD-04, Drawings

- a. Precast concrete manhole
- b. Metal items

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store rubber gaskets under cover out of direct sunlight. Do

not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

2.1.1 Ductile Iron Pressure Piping

2.1.1.1 Ductile Iron Pressure Pipe and Fittings

Ductile-iron pipe shall conform to ANSI/AWWA C151/A21.51, Thickness Class 150. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint.

2.1.1.2 Ductile Iron Pressure Joints and Jointing Materials

- a. Joints, general: Joints for pipe and fittings shall be push-on joints or mechanical joints except as otherwise specified in this paragraph. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint. Grooved or shouldered type joints may be used in lieu of push-on joint or flanged joint, except where joint is buried.
- b. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11.
- c. Mechanical joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111/A21.11.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Precast Concrete and Associated Materials

2.2.1.1 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923.

2.2.1.2 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of

sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for

Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elongation %	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, %, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, %, 2 hours	ASTM C 972	-	-	12

2.2.2 Metal Items

2.2.2.1 Frames, Covers, and Gratings for Manholes

FS RR-F-621, cast iron; figure numbers shall be as follows:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

2.2.2.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required

in manholes less than 4 feet deep.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building.

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved water pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary piping crossing water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 18 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

- c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill."

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

- a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have

dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint and assemble in accordance with the recommendations of the coupling manufacturer, as approved. Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.

- b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A polyethylene film.
- c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94 having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods.

-- End of Section --

SECTION 02582

ELECTRICAL MANHOLE AND HANDHOLE

09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB14 (1992) Highway Bridges

AASHTO M198 (1975; R 1993) Joints for Circular
Concrete Sewer and Culvert Pipe Using
Flexible Watertight Gaskets

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315 (1994) Details and Detailing of Concrete
ReinforcementACI 318 (1995) Building Code Requirements for
Reinforced Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 32 (1993) Sewer and Manhole Brick (Made from
Clay or Shale)

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621 (Rev. E) Frames, Covers, Gratings, Steps,
Sump and Catch Basin, Manhole

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

1.2 RELATED REQUIREMENTS

Section 16303, "Underground Electrical Work" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Precast concrete structures G
- b. Manhole and Handhole Frames and covers G
- c. Sealing material for precast manhole and handhole joints G
- d. Cable racks, arms and insulators G

1.3.2 SD-04, Drawings

- a. Precast manhole and handhole G
- b. Pulling-in irons G

1.3.2.1 Precast Manhole and Handhole G

Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

- a. Material description (i.e., f'c and Fy)
- b. Manufacturer's printed assembly and installation instructions
- c. Design calculations
- d. Reinforcing shop drawings prepared in accordance with ACI 315.
- e. Plans and elevations showing opening and pulling-in iron locations and details.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Underground Structures

2.1.1.1 Manholes and Handholes

Provide type indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.1.1.2 Metal Frames and Covers

Provide cast iron frames and covers for manholes conforming to FS RR-F-621.

2.1.1.3 Drainage Pipe and Fittings

Cast-iron, extra strength. Drains shall be cast-iron, coated or uncoated, plain pattern, bottom outlet with perforated or slotted hinged cover.

2.1.1.4 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

2.1.2 Cable Racks, Arms and Insulators

Metal portion of racks and arms shall be zinc-coated after fabrication.

2.1.2.1 Cable Racks

Wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16-inch by 48-inches long (minimum) channel steel. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.1.2.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type.

2.1.2.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.1.3 Cast-In-Place Manholes and Handholes

2.1.3.1 Precast Concrete Construction

In lieu of cast-in-place concrete manholes and handholes, the Contractor may, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

- a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi.

Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

- b. Construction structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels designed for future duct bank entrances shall not be permitted.

Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

- c. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.1.3.2 Metal Frames and Covers

Shall be made of cast iron. Cast-iron frames and covers shall meet FS RR-F-621.

2.1.3.3 Pulling-In Irons

Shall be steel bars bent in the form indicated and cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole. Pulling-in irons shall project into the manhole approximately 4 inches. Iron shall be hot-dipped galvanized after fabrication.

2.1.3.4 Cable Racks

Including rack arms and insulators, shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced no more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. The wall bracket shall be channel steel. Slots for mounting cable rack arms shall be spaced at 8 inch intervals. The cable rack arms shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be hot-dip galvanized after fabrication.

2.1.3.5 Grounding in Manholes and Handholes

Provide No. 6 AWG bare copper grounding pigtailed on walls of each manhole and handhole. The pigtailed shall be exothermically welded to the

reinforcing bars and shall extend at least 8 inches into manhole and handhole. Two pigtails shall be provided in each manhole and handhole.

2.1.3.6 Precast Manholes and Handholes Installation

Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to one-inch size, extending 12 inches beyond the manhole and handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

2.1.3.7 Field Painting

Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70 and ANSI C2.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psiminimum ultimate 28-day compressive strength with one-inchminimum aggregate conforming to the requirements of Section 03300, "Cast-In-Place Concrete".

3.1.3 Precast Concrete Construction

3.1.3.1 Precast Concrete Construction

In lieu of cast-in-place, the Contractor may, at his option, provide precast concrete manholes and handholes, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

- a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi.

Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

- b. Design for precast structures: ACI 318. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:
- (1) Angle of internal friction (ϕ): 30 degrees
 - (2) Unit weight of soil (dry): 110 pcf, (saturated): 130 pcf
 - (3) Coefficient of lateral earth pressure (K_a) = 0.33
 - (4) Ground water level: 3 feet below ground elevation
 - (5) Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. Minimum design vertical load shall be for H20 highway loading per AASHTO HB14.
 - (6) Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered along with a pulling-in iron design load of 6000 pounds.
 - (7) Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.
 - (8) Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.
- c. Construction: Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at

least two No. 4 bars around window openings. Minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 4 inches deep.

- d. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

3.1.3.2 Metal Frames and Covers for Handholes

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of galvanized steel with bronze hinge pin, 5 by 5 inches by approximately 3/16-inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. Surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

3.1.3.3 Pulling-In Irons

Pulling-in irons shall be steel bars bent as indicated and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. Final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6-inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3-foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.1.3.4 Cable Racks

Cable racks, arm and insulators shall be sufficient to accommodate the cables. Racks in power manholes and handholes shall be spaced not more than 3 feet apart, and each manhole and handhole wall shall be provided with a minimum of two racks. Racks in signal manholes and handholes shall be spaced not more than 16-1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Rack arm length shall be a minimum of 8-inches and a maximum of 12 inches. Methods of anchoring cable racks shall be as follows:

- a. Provide a 5/8-inch diameter by 5-inch long anchor bolt with 3-inch foot cast in structure wall with 2-inch protrusion of threaded portion of bolt into structure. Provide 5/8-inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with white lead immediately prior to installing nuts.
- b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8-inch steel nuts in channel insert type receive 5/8-inch diameter by 3-inch long steel, square head anchor bolts.
- c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800-pound load rating. Provide 5/8-inch diameter by 3-inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with white lead immediately prior to installing bolts.

3.1.3.5 Grounding in Manholes and Handholes

Provide a No. 1/0 AWG bare copper cable on each manhole and handhole sidewall. The cables shall be exothermically welded to the ground rod in the manhole and handhole, and shall be accessible for future grounding requirements.

3.1.3.6 Precast Manholes and Handholes Installation

Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the manhole and handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Installation shall conform to the manufacturer's instructions.

3.1.3.7 Field Painting

Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.1.4 Earthwork for Utilities

Section 02302, "Excavation, Backfilling, and Compacting for Utilities."

-- End of Section --

SECTION 02630

STORM DRAINAGE
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M198 (1990; R 1993) Joints for Circular
Concrete Sewer and Culvert Pipe Using
Flexible Watertight Gaskets

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102 (1988) Concrete Pipe Handbook

ACPA 01-103 (1990) Concrete Pipe Installation Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76 (1995) Reinforced Concrete Culvert, Storm
Drain, and Sewer Pipe

ASTM C 150 (1995) Portland Cement

ASTM C 443 (1994) Joints for Circular Concrete Sewer
and Culvert Pipe, Using Rubber Gaskets

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Concrete piping including fittings and jointing materials

1.2.2 SD-04, Drawings

- a. Precast concrete structures

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.2 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care not to damage coating and lining on pipe and fittings; if damaged, make repairs. Carry, do not drag pipe to trench.

PART 2 PRODUCTS

2.1 CULVERT MATERIALS

2.1.1 Concrete Piping

2.1.1.1 Concrete Pipe and Fittings

Culvert pipe shall be Class III reinforced pipe conforming to ASTM C 76. Cement used in manufacturing pipe and fittings shall be Type II conforming to ASTM C 150.

2.1.1.2 Joint Sealants

Provide primers and lubricants as recommended by the manufacturer. Concrete pipe joints shall be suitable for use with the joint sealants specified.

- a. Butyl gaskets.
- b. ASTM C 443 rubber O-ring gaskets.
- c. AASHTO M198, Type B preformed plastic gaskets.

2.2 FLARED ENDS

Flared end sections shall be same material as pipe material except that only reinforced concrete flared ends shall be provided for concrete pipe.

2.3 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 8 inches.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to pipeline installation except where specific exception is made under paragraph entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill."

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to produce a uniform space. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper calking or installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.2 Special Requirements

3.1.2.1 Installation of Concrete Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9. Make joints with the gaskets previously specified for joints with this piping. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within one inch of closure, remove the pipe and remake the joint.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

3.2.2 Pipeline Testing

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

-- End of Section --

SECTION 02741

BITUMINOUS CONCRETE PAVEMENT
12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T30	(1993) Mechanical Analysis of Extracted of Aggregate
AASHTO T230	(1968; R 1993) Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(1993) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2950	(1991) Density of Bituminous Concrete in Place by Nuclear Methods

FEDERAL SPECIFICATIONS (FS)

FS TT-P-115	(Rev. F) Paint, Traffic (Highway, White and Yellow)
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STATE HIGHWAY SPECIFICATION (SHS)

SHS MDOT	(1993) Maryland Department of Transportation, State Highway Administration, Standard Specification for Construction and Materials
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1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Precast car stops

1.2.2 SD-08, Statements

a. Asphalt mix delivery record

- b. Asphalt concrete and material sources

1.2.2.1 Mix Delivery Record Data

Record and submit the following information to each load of mix delivered to the job site. Submit within one day after delivery on Government-furnished forms:

- a. Truck No:
- b. Time In:
- c. Time Out:
- d. Tonnage and Discharge Temperature:
- e. Mix Type:
- f. Location:
- g. Stations Placed:

1.2.2.2 Materials

Obtain approval of the Contracting Officer for materials and material sources 2 days prior to the use of such material in the work.

1.2.3 SD-11, Factory Test Reports

- a. Trial batch reports
- b. Mix design

1.2.3.1 Trial Batch

Submit current bituminous design reports for all mix types proposed for use on the project.

1.2.3.2 Mix Design

Submit results of laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to date of material placement.

1.2.4 SD-12, Field Test Reports

- a. Asphalt concrete
- b. Density
- c. Thickness
- d. Straightedge test

Submit reports for testing specified under paragraph entitled "Field Quality Control."

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Provide work and materials in accordance with applicable requirements of WVDOT RBSS. Paragraphs in WVDOT RBSS entitled "Measurement and Payment" shall not apply.

1.3.2 Modification of References

Where term "Engineer" is used in SHS MDOT it shall be construed to mean Contracting Officer. Where term "state" is used, it shall mean "Federal Government."

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

Provide asphalt concrete in accordance with the applicable requirements of the WVDOT RBSS, except where specified otherwise.

2.2 SUBBASE MATERIALS

Conform to SHS MDOT, Section 901.01, graded aggregate subbase.

2.3 BASE COURSE MATERIALS

Conform to SHS MDOT, Section 904.06, hot mix asphalt base course.

2.4 SURFACE COURSE MATERIALS

Wearing course shall conform to SHS MDOT, Section 904.06, Type A, hot mix asphalt surface course.

2.5 STRIPING

Paint shall conform to FS TT-P-115, Types I, or II.

2.6 CURBS AND GUTTERS

WVDOT RBSS, materials for construction of curbs and gutters shall be in accordance with Section 610.2.

2.7 COMPOSITION OF MIXTURE REQUIREMENTS

2.7.1 Mixture Properties

Gradation of mineral aggregate shall be as specified. Percentage of bituminous material provided in the bituminous mixtures shall be within the limits specified. Mixtures shall have the following physical properties:

<u>Test Property</u>	<u>Values</u>
Stability (50 Blows)	Not less than 1000 pounds
Flow (0.01 inch)	Not more than 20 nor less than 8
Percent Air Voids	Not less than 3 nor more than 8 for binder course; not less than 3 nor more than 5 for wearing course
Percent Voids in Mineral Aggregates	See Table I

Test Property Values

TABLE I

MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE (VMA)

<u>U.S.A. Standard Sieve Designation</u>	<u>Nominal Maximum Particle Size, Inch</u>	<u>Minimum VMA Percent</u>
No. 4	0.187	18
3/8 inch	0.375	16
1/2 inch	0.500	15
3/4 inch	0.750	14
1 inch	1.000	13

2.7.2 Quantity of Bituminous Material

Mix asphalt cement with aggregates of corresponding mixes in the following proportions:

ASPHALT CEMENT PERCENT BY WEIGHT OF TOTAL MIX

<u>Binder Course</u>	<u>Wearing Course</u>
4 to 8	5 to 9

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Excavation and Filling

Excavation and filling to establish elevation of subgrade is specified in Section 02315, "Excavation and Fill."

3.2 CONSTRUCTION

3.2.1 Subgrade

Preparation of subgrade shall be in accordance with Section 02315, "Excavation and Fill."

3.2.2 Subbase

SHS MDOT, methods of construction of the subbase shall be in accordance with Section 501.

3.2.3 Base Course

SHS MDOT, methods of construction of the base course shall be in accordance with Section 504.

3.2.4 Surface Course

SHS MDOT, methods of construction of the surface course shall be in accordance with Section 504. Placement will not be permitted unless the Contractor has a working asphalt thermometer on site.

3.3 FIELD QUALITY CONTROL

Sample shall be taken by Contractor as specified herein. Contractor shall replace pavement where sample cores have been removed.

3.3.1 Sample and Core Identification

Place each sample and core in a container and securely seal to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

- a. Contract No.
- b. Sample No.
- c. Quantity
- d. Date of Sample
- e. Sample Description
- f. Source/Location/Stations Placed/depth below the finish grade
- g. Intended Use
- h. Thicknesses of various lifts placed

3.3.2 Testing

3.3.2.1 Bituminous Mix Testing

Take two samples per day per mix type at plant or from truck. Test uncompacted mix for extraction in accordance with ASTM D 2172 and sieve analysis in accordance with AASHTO T30. Test samples for stability and flow in accordance with ASTM D 1559. When two consecutive tests fail to meet requirements of specifications, cease placement operations and test a new trial batch prior to resumption of placement operations.

3.3.2.2 Testing of Pavement Course

- a. Density: Determine density of pavement by testing cores obtained from the binder and wearing course in accordance with AASHTO T230. Take three cores at location designated by Contracting Officer for each 200 tons, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to laboratory and provide test results within 48 hours of each day placement of paving materials.
- b. Thickness: Determine thickness of the binder and wearing course from cores taken for density test.
- c. Straightedge Test: Test compacted surface of binder course and wearing course with a straightedge as work progresses. Apply straightedge parallel with and at right angles to center line

after final rolling. Variations in the binder course surface shall not be more than 1/4 inch from the lower edge of the 10 foot straightedge; variations in wearing course surface shall not be more than 3/16 inch from the lower edge of the 10 foot straightedge. Pavement showing irregularities greater than that specified shall be corrected as directed by Contracting Officer.

3.3.2.3 Alternate Testing Method for Pavement Courses

At Contractor's option the following in-place testing method may be used to determine density and thickness in lieu of testing specified above. Frequency of testing shall be the same. When in-place nuclear method to determine density is used, take two pavement cores at locations designated by Contracting Officer and turn over to Government to verify pavement thickness.

- a. Density: Determine density of pavement by in-place testing using Nuclear Method in accordance with ASTM D 2950.
- b. Thickness: Determine thickness of finished pavement by use of following equation:

$$t = \frac{W}{0.75d}$$

Where t = pavement thickness, in inches.

W = average weight per square yard of mixture actually used in work.

d = compacted density as measured by nuclear density device.

-- End of Section --

SECTION 03100

CONCRETE FORMS AND ACCESSORIES
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301 (1994) Structural Concrete for Buildings

ACI 347R (1994) Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1982; R 1988) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 39 (1994) Compressive Strength of Cylindrical Concrete Specimens

CORPS OF ENGINEERS (COE)

COE CRD-C-572 (1974) Polyvinylchloride Waterstop

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-1 (1995) Construction and Industrial Plywood

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood: PS-1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C-572. Water stop shape as indicated.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of the design strength.

3.2 Waterstop Splices

Fusion weld in the field.

3.3 Formed Surfaces

3.3.1 Tolerances

ACI 347R and as indicated.

3.3.2 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

-- End of Section --

SECTION 03200

CONCRETE REINFORCEMENT
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
|---------|--|
| ACI 301 | (1996) Structural Concrete for Buildings |
| ACI 315 | (1994) Details and Detailing of Concrete Reinforcement |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM A 82 | (1995) Steel Wire, Plain, for Concrete Reinforcement |
| ASTM A 496 | (1995) Steel Wire, Deformed, for Concrete Reinforcement |
| ASTM A 616/A 616M | (1995; Rev. B) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement |
| ASTM A 617/A 617M | (1995; Rev. B) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement |

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-04, Drawings

a. Reinforcing steel

Reproductions of contract drawings are unacceptable.

1.2.1.1 Reinforcing Steel

ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.3 DELIVERY, STORAGE, AND HANDLING

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 REINFORCEMENT

2.1.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A 615/A615M and ASTM A 617/A 617M with the bars marked A, Grade 60; or ASTM A 616/A 616M with the bars marked R, Grade 60.

2.1.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.1.3 Wire

ASTM A 82 or ASTM A 496.

2.1.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or noncorrodible material.

PART 3 EXECUTION

3.1 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.1.1 Reinforcement Supports

Place reinforcement and secure with noncorrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other noncorrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.1.2 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress.

3.1.3 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

-- End of Section --

SECTION 03300

CAST-IN-PLACE CONCRETE
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117 (1990) Tolerances for Concrete Construction and Materials

ACI 211.1 (1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete

ACI 213R (1987) Structural Lightweight Aggregate Concrete

ACI 301 (1994) Structural Concrete for Buildings

ACI 302.1R (1989) Concrete Floor and Slab Construction

ACI 304R (1989) Measuring, Mixing, Transporting, and Placing Concrete

ACI 304.2R (1991) Placing Concrete by Pumping Methods

ACI 305R (1991) Hot Weather Concreting

ACI 306.1 (1990) Cold Weather Concreting

ACI 318 (1995) Building Code Requirements for Reinforced Concrete

ACI 347R (1994) Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31 (1991) Making and Curing Concrete Test Specimens in the Field

ASTM C 33 (1993) Concrete Aggregates

ASTM C 39 (1994) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42	(1994) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 143	(1990; Rev. A) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 173	(1994; Rev. A) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1991; Rev. B) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1994) Air-Entraining Admixtures for Concrete
ASTM C 309	(1994) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595	(1994; Rev. A) Blended Hydraulic Cements
ASTM C 618	(1994; Rev. A) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 1107	(1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 4397	(1991) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

1.2 DEFINITIONS

- a. "Cementitious material" as used herein shall include all portland cement, pozzolan, fly ash, and ground iron blast-furnace slag.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Materials for curing concrete
- b. Vapor barrier

1.3.2 SD-05, Design Data

- a. Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. An identical concrete mix design previously approved within the past 12 months by the Atlantic Division, Naval Facilities Engineering Command, may be used without further approval, if copies of the previous approval and fly ash, and pozzolan test results are submitted. The approval of fly ash, and pozzolan tests results shall have been within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

1.3.3 SD-08, Statements

- a. Pumping concrete

1.3.3.1 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal shall include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete will be pumped.

1.3.4 SD-10, Test Reports

- a. Concrete mix design

1.3.4.1 Concrete Mix Design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, ACI 318, ACI 304.2R, ACI 213R except as otherwise specified. The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'c (Min. 28- Day Comp. Strength) (psi)	ASTM C 33 Aggregate (Size No.)	Range of Slump (inches)	Water- Cement Ratio (by weight)	Air Entr. (percent)
All areas	4000	1"	3 - 5	.45	3.5-6.5

Maximum slump shown above may be increased one inch for methods of consolidation other than vibration. Provide air entrainment using air-entraining admixture.

2.1.1.1 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows:

- For f'c less than 3000 psi, 1000 psi plus f'c.
- For f'c between 3000 and 5000 psi, 1200 psi plus f'c.
- For f'c over 5000 psi, 1400 psi plus f'c.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type II or ASTM C 595, Type IP(MS) blended cement except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash. The pozzolan or fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type F, except that the maximum allowable loss on ignition shall be 6 percent for Type F. Add with cement.

2.2.2 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.2.3 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.2.4 Nonshrink Grout

ASTM C 1107.

2.2.5 Admixtures

Calcium chloride shall not be used as an admixture.

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.6 Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum 10 mil thickness.

2.2.6.1 Polyethylene Sheeting

ASTM D 4397, minimum 10 mil thickness.

2.2.7 Materials for Curing Concrete

2.2.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.2.7.2 Pervious Sheeting

AASHTO M182.

2.2.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.2.8 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals

and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.2.9 Epoxy Bonding Compound

ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

PART 3 EXECUTION

3.1 PLACING MISCELLANEOUS MATERIALS

3.1.1 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement shall not damage vapor barrier material.

3.1.2 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.1.3 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.2 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.2.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.2.2 Mixing

ASTM C 94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is

less than 85 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.2.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.3 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.3.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width shall be a minimum of 4 inches greater than indicated.

3.3.2 Vibration

ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 18 inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.3.3 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is

stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.3.4 Pumping

ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of coarse aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

3.3.5 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.3.6 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.4 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.4.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.4.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.4.3 Formed Surfaces

3.4.3.1 Tolerances

ACI 117 and as indicated.

3.4.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch this holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.5 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor shall provide straightedge.

3.5.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.5.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below, the surface shall be roughened with stiff brushes or rakes before final set.

3.5.1.2 Floated

Use for slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.5.1.3 Steel Troweled

Use for floors intended as walking surfaces. First, provide a floated finish. The finish shall next be power troweled three times, and finally hand troweled. The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some

trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. The finished surface shall produce a surface level to within 1/4 inch in 10 feet.

3.5.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.5.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary.

Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained or obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.5.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish.

Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.5.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.5.4 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.5.5 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and shall be 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.6 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.6.1 Moist Curing

Remove water without erosion or damage to the structure.

3.6.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.6.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.6.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.6.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.6.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.6.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.6.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.6.3 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.6.4 Curing Periods

ACI 301 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that will be in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Contracting Officer.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31 for making test specimens.

3.7.2 Testing

3.7.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.7.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.7.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than $f'c$ or if any strength test result falls below $f'c$ by more than 500 psi, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of $f'c$ and if no single core is less than 75 percent of $f'c$. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.7.2.4 Air Content

ASTM C 173 or ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

-- End of Section --

SECTION 04200

UNIT MASONRY
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 530.1 (1995) Masonry Structures (ASCE 6-95)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1995; Rev. A) Steel Wire, Plain, for
Concrete Reinforcement

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and
Steel Hardware

ASTM A 615/A 615M (1995; Rev. C) Deformed and Plain
Billet-Steel Bars for Concrete
Reinforcement

ASTM A 616/A 616M (1996) Rail-Steel Deformed and Plain Bars
for Concrete Reinforcement

ASTM C 90 (1995) Load-Bearing Concrete Masonry Units

ASTM C 91 (1995; Rev. B) Masonry Cement

ASTM C 94 (1995) Ready-Mixed Concrete

ASTM C 144 (1993) Aggregate for Masonry Mortar

ASTM C 150 (1995) Portland Cement

ASTM C 207 (1991; R 1992) Hydrated Lime for Masonry
Purposes

ASTM C 270 (1995; Rev. A) Mortar for Unit Masonry

ASTM C 476 (1995) Grout for Masonry

ASTM C 780 (1994) Preconstruction and Construction
Evaluation of Mortars for Plain and
Reinforced Unit Masonry

ASTM C 1019 (1989; Rev. A, R 1993) Sampling and
Testing Grout

ASTM C 1142 (1995) Extended Life Mortar for Unit

Masonry

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Masonry accessories
- b. Reinforcement
- c. Pre-mixed mortar
- d. Flashing

Submit for each type.

1.2.2 SD-04, Drawings

- a. Reinforcing steel

1.2.2.1 Drawing Requirements

Indicate splicing, laps, shapes, dimensions, and details of reinforcing steel, and accessories. Include details of anchors, positioning devices, bond beams, and lintels. Do not scale drawings to determine lengths of bars.

1.2.3 SD-05, Design Data

- a. Pre-mixed mortar

1.2.4 SD-06, Instructions

- a. Masonry cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.2.5 SD-11, Factory Test Reports

- a. Unit strength method
- b. Mortar properties
- c. Grout

1.2.6 SD-12, Field Test Reports

- a. Grout strength
- b. Mortar strength and properties

1.2.7 SD-13, Certificates

- a. Concrete masonry units

1.2.8 SD-14, Samples

a. Masonry units G

Submit two sets of each type masonry units, showing full range of color, texture, finish, and dimensions.

1.3 QUALITY ASSURANCE

1.3.1 Appearance

Do not change source or supply of materials after work has started if the appearance of the finished work would be affected.

1.3.2 Testing

Masonry strength shall be determined in accordance with ACI 530.1 and the cost of testing shall be paid by the Contractor.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver cementitious materials to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures and handle so as to prevent entry of foreign materials and damage by water or dampness. Store masonry units off the ground and handle with care to avoid chipping and breakage. Protect materials from damage and, except for sand, keep dry until used. Cover sand to prevent intrusion of water and foreign materials and to prevent drying. Do not use materials containing frost or ice. Store Type II, concrete masonry units at the site for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Protect moisture controlled units (Type I) from rain and ground water.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Hot Weather Construction

ACI 530.1.

1.5.2 Cold Weather Construction

ACI 530.1.

1.6 SCHEDULING

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching.

1.7 BRACING

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 MASONRY UNITS

2.1.1 Concrete Masonry Units

Units of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture.

- a. Hollow Load-Bearing Units: ASTM C 90, Type I or II, made with lightweight, medium weight, or normal weight aggregate. Provide load-bearing units for all masonry construction.
- b. Special Shapes: Provide special shapes such as closures, header units, and jamb units as necessary to complete the work. Special shapes shall conform to the requirements for the units with which they are used.

2.2 MORTAR

2.2.1 Mortar Properties

ASTM C 270, Type S for masonry work. Compressive strength shall equal 1,500 psi.

2.2.1.1 Portland Cement

ASTM C 150, Type I or II.

2.2.1.2 Hydrated Lime

ASTM C 207, Type S.

2.2.1.3 Masonry Cement

ASTM C 91, Type S. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.2.1.4 Sand

ASTM C 144.

2.2.1.5 Water

Clean, potable, and free from substances which could adversely affect the mortar.

2.2.2 Pre-Mixed Mortar

ASTM C 1142, Type RS.

2.3 GROUT

ASTM C 476, coarse. Slump between 8 and 11 inches. Provide minimum grout strength of 2000 psi in 28 days, as tested by ASTM C 1019.

2.3.1 Ready-Mixed Grout

ASTM C 94.

2.4 MASONRY ACCESSORIES

2.4.1 Horizontal Joint Reinforcement

Fabricate from cold drawn steel wire, ASTM A 82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A 153/A 153M, Class B-2, 1.5 ounces of zinc per square foot. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Provide flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2 inches less than nominal thickness of wall.

2.4.1.1 Single-Wythe

For single-wythe walls and partitions, provide two 9 gage 0.1483 inch longitudinal wires and 9 gage cross wires.

2.4.2 Fastenings

Build in bolts, metal wall plugs, and other metal fastenings furnished under other sections for securing furring and other items.

2.4.3 Reinforcing Bars

ASTM A 615/A 615M or ASTM A 616/A 616M.

2.4.3.1 Fabrication

ACI 530.1.

2.4.3.2 Bar Positioners

Provide positioners that prevent displacement of reinforcing during construction.

2.4.4 Sealant

Sealant as specified in Section 07920, "Joint Sealants."

2.5 SOURCE QUALITY CONTROL

2.5.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530.1. Submit calculations and certifications of unit and mortar strength.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530.1, inspection. The Officer in Charge of Construction will serve as inspector or will select a masonry inspector.

3.1.1 Protection

- a. Stains: Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or

polyethylene.

- b. Loads: Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.
- c. Provide temporary bracing as required.

3.1.2 Surface Preparation

Surfaces on which masonry is to be placed shall be smooth, clean, and free of foreign substances when mortar is applied.

3.2 FIELD QUALITY CONTROL

3.2.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.2.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready-mixed grout.

3.3 WORKMANSHIP

Carry masonry up level and plumb. Furnish and use story poles or gage rods throughout the work. Changes in coursing or bonding after the work is started will not be permitted. Do not carry one section of the walls up in advance of the others. Step back unfinished work for joining with new work. Toothing will not be permitted. Check heights of masonry at each floor and at sills and heads of openings to maintain the level of the walls. Build in door and window frames, louvered openings, anchors, pipes, ducts, and conduits as the masonry work progresses. Fill spaces around metal door frames solidly with mortar. Handle masonry units with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Cut masonry with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Provide chases of approved dimensions for pipes and other purposes where indicated and where necessary. Cover tops of exposed walls and partitions not being worked on with a waterproof membrane secured in place and extended down at least 2 feet on both sides. Inspect scaffolding regularly to ensure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

3.4 MORTAR MIXING

Measure mortar materials in 1 cu. ft. containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Mix mortar in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Add water gradually as required to produce a workable consistency. Do not load mixer beyond its rated capacity. Keep mortar boxes, pans, and mixer drums clean and free of debris and dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing to obtain a workable consistency. Do not use or retemper mortar which has not been placed in final position within 2 1/2 hours after the initial mixing. Do

not use antifreeze compounds, salts, or other substances to lower the freezing point of mortar.

- a. Mortar: Mix mortar in accordance with ASTM C 270 to obtain type mortar required. When masonry cement is provided, conform to masonry cement manufacturer's printed mixing instructions.
- b. Grout: ASTM C 476. Provide fine grout in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Provide coarse grout in grout spaces 2 inches or greater in all horizontal dimensions provided the clearance between reinforcing and masonry is not less than 3/4 inch.

3.5 MORTAR JOINTS

Uniform thickness of 3/8 inch unless otherwise indicated. Tool exposed joints slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. For horizontal joints, jointers shall be at least 16 inches long. Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Strike flush joints that will not be exposed. Tool vertical joints first. Brush joints to remove all loose and excess mortar. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

3.6 TOLERANCES

Masonry work shall be within the following limits:

- a. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.
- b. Variation From True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.
- c. Variation From Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.
- d. Variation From Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.
- e. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.7 CONCRETE MASONRY UNIT WORK

Lay the first course in a full bed of mortar for the full width of the unit. Lay succeeding courses in running bond unless otherwise indicated. Form bed-joints by applying mortar to entire top surfaces of inner and outer face shells. Form head joints by applying mortar for a width of about 1 inch to ends of adjoining units. Mortar shall be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, place metal lath in the joint at the bottom of such cells and fill cells with mortar or grout as work progresses. Provide concrete brick for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Do not dampen concrete masonry units before or

during laying.

3.7.1 Special Concrete Masonry Unit Work

Select units for bond beams for uniformity of size, texture, true plane, and undamaged edges and ends of exposed surfaces. Place units plumb, parallel, and with properly tooled joints of maximum 3/8 inch thickness. Keep exposed surfaces clean and free from blemishes or defects. Lay units in the bond pattern indicated.

3.7.2 Reinforced Concrete Masonry Unit Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.8 BONDING AND ANCHORING

Unless indicated otherwise, extend partitions from the floor to the bottom of the construction above. Structurally bond or anchor walls and partitions to each other and to concrete slabs, walls, beams, and columns. Securely anchor non-load-bearing partitions and interior walls to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Completely embed anchors in mortar joints.

- a. Corners of Load-Bearing Walls: Provide a true masonry bond in each course, except where indicated or specified otherwise.
- b. Intersections of Load-Bearing Walls: Provide a true masonry bond in each course.
- c. Provide solid grouted cells for anchoring plumbing fixtures, grab bars, or any other equipment permanently mounted to masonry walls.

3.9 HORIZONTAL JOINT REINFORCEMENT

Provide reinforcement where indicated in walls of concrete masonry units. Reinforcement shall be continuous. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Provide reinforcement in the longest available lengths, utilizing the minimum number of splices. Overlap ends not less than 6 inches. Provide welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement, at corners and intersections of walls and partitions. Provide mortar cover for the wire of at least 1/2 inch.

3.10 CONCRETE MASONRY UNIT LINTELS AND BOND BEAMS

Provide special units, fill cells solidly with grout or concrete, and provide not less than two No. 5 reinforcing bars, unless indicated

otherwise. Reinforcing shall overlap a minimum of 40 bar diameters at splices. Concrete masonry units provided for lintels and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end. Allow lintels to set at least 6 days before shoring is removed.

3.11 GROUT PLACEMENT

Place grout from the interior side of walls, unless approved otherwise. Protect sills, ledges, offsets, and other surfaces from grout droppings. Remove grout from such surfaces immediately. Grout shall be well mixed to prevent segregation and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Place grout by pumping or pouring from buckets equipped with spouts in lifts not exceeding 4 feet. Keep pours at 1 1/2 inches below top of masonry units in top course, except at finish course. Puddle or agitate grout thoroughly to eliminate voids. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.12 FORMS AND SHORING

Construct to the shape, lines, and dimensions of members indicated. Prevent deflections which may result in cracking or other damage to supported masonry. Do not remove until members have cured.

3.13 CLEANING

3.13.1 Protection

During cleaning operations, protect work which may be damaged, stained, or discolored.

3.13.2 Pointing

Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

3.13.3 Cleaning

Clean exposed masonry surfaces with clear water and stiff fiber brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue scrubbing with warm water and detergent. Immediately after cleaning each area, rinse thoroughly with clear water. Do not use caustic solutions or sandblasting to clean surfaces. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris. Restore damaged, stained, and discolored work to original condition or provide new work.

-- End of Section --

SECTION 05500

METAL FABRICATIONS
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

- | | |
|-------|--|
| AA 45 | (1980) Aluminum Finishes |
| AA 46 | (1978) Anodized Architectural Aluminum |

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- | | |
|------------|---|
| AISC S303 | (1992) Steel Buildings and Bridges |
| AISC S342L | (1993) Load and Resistance Factor Design
Specification for Structural Steel
Buildings |
| AISC S335 | (1989) Structural Steel Buildings
Allowable Stress Design and Plastic Design |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|---------------|---|
| ANSI B18.2.1 | (1981; R 1992) Square and Hex Bolts and
Screws Inch Series |
| ANSI B18.6.2 | (1972; R 1993) Slotted Head Cap Screws,
Square Head Set Screws, and Slotted
Headless Set Screws |
| ANSI B18.6.3 | (1972; R 1991) Machine Screws and Machine
Screw Nuts |
| ANSI B18.21.1 | (1994) Lock Washers (Inch Series) |
| ANSI B18.22.1 | (1965; R 1990) Plain Washers |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-------------------|---|
| ASME/ANSI B18.2.2 | (1987; R 1993) Square and Hex Nuts (Inch
Series) |
|-------------------|---|

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-----------------|---|
| ASTM A 36/A 36M | (1994) Carbon Structural Steel |
| ASTM A 47 | (1990) Ferritic Malleable Iron Castings |

ASTM A 53	(1994) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 653/A 653M	(1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B 26/B 26M	(1992; Rev. A) Aluminum-Alloy Sand Castings
ASTM B 108	(1994) Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(1993) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1993) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM B 429	(1992; Rev. A) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 1187	(1995) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel
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CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.27	Fixed Ladders
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1924	Shield, Expansion (Self Drilling Tubular Expansion Shell)
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FEDERAL SPECIFICATIONS (FS)

FS TT-P-664 (Rev. D) Primer Coating, Alkyd,
Corrosion-Inhibiting, Lead and Chromate
Free, VOC-Compliant

FS RR-G-1602 (Rev. C) Grating, Metal, Other Than Bar
Type (Floor, Except for Naval Vessels)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM BG (1988) Metal Bar Grating Manual

NAAMM PR (1995) Pipe Railing Manual

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3 (1989) Power Tool Cleaning

SSPC SP 6 (1991) Commercial Blast Cleaning

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Cover plates and frames
- b. Floor gratings
- c. Handrails
- d. Ladders
- e. Aluminum stairs
- f. Structural steel door frames

1.2.2 SD-04, Drawings

- a. Fabrication drawings of aluminum stairs
- b. Fabrication drawings of structural steel door frames
- c. Cover plates and frames, installation drawings
- d. Floor gratings, installation drawings
- e. Handrails, installation drawings
- f. Ladders, installation drawings
- g. Embedded angles and plates, installation drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC S303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Structural Tubing

ASTM A 500.

2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47.

2.1.5 Gratings

a. Metal bar type grating NAAMM BG.

2.1.6 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.6.1 Expansion Anchors

CID A-A-1924, of Group II, Type 4, Class 1. Provide embedment required by manufacturer.

2.1.6.2 Bolts, Nuts, Studs and Rivets

ASME/ANSI B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.6.3 Screws

ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3.

2.1.6.4 Washers

Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1.

2.1.7 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123, ASTM A 153 or ASTM A 653/A 653M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Unexposed Sheet, Plate, and Extrusions

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA 45, or AA 46.

2.3 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface. Plate shall be galvanized. Reinforce to sustain a live load of 100 pounds per square foot. Frames shall be structural steel shapes and plates, with bent steel bars or headed anchors welded to frame for anchoring to concrete or securely fastened to the structure as indicated. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide flush drop handles for removal formed from 1/4 inch round stock where indicated. Provide holes and openings with 1/2 inch clearance for pipes and equipment. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

2.4 FLOOR GRATINGS

Design aluminum grating in accordance with NAAMM BG for bar type grating or manufacturer's charts for plank grating.

- a. Design floor gratings to support a live load of 100 pounds per square foot for the spans indicated, with maximum deflection of $L/240$.
- b. NAAMM BG, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

--or--

- c. Attach gratings to structural members with welded-on anchors or anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.
- d. Slip resistance requirements FS RR-G-1602.

2.5 GUARD POSTS (BOLLARDS)

Provide 8 inch prime coated standard weight steel pipe as specified in ASTM A 53. Anchor posts in concrete as indicated and fill solidly with concrete

with minimum compressive strength of 2500 psi.

2.6 HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 50 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM PR, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.6.1 Aluminum Handrails

Consists of 1 1/2 inch nominal schedule 40 pipe ASTM B 429. Railings shall be anodized aluminum clear color. All fasteners shall be Series 300 stainless steel.

a. Fabrication: Provide jointing by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed head set screws.

(2) Mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.

(3) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B 26/B 26M.

2.7 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers.

2.8 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated.

Galvanize embedded items exposed to the elements according to ASTM A 123.

2.9 SAFETY TREADS

NAAMM BG aluminum, Type P.

2.10 ALUMINUM STAIRS

Provide aluminum stairs complete with stringers, grating treads, landings, columns, handrails, and necessary bolts and other fastenings.

2.10.1 Design Loads

Design stairs to sustain a live load of not less than 100 pounds per square foot, or a concentrated load of 300 applied where it is most critical. Conform to AISC S335 or AISC S342L with the design and fabrication of steel stairs, other than a commercial product.

2.10.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Screw or screw-type connections are not permitted.

- a. Gratings for Treads and Landings: Plank grating; ASTM B 209 for aluminum. Provide gratings with nonslip nosings.
- b. Support aluminum grating on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Close exposed ends. Exterior stairs shall have all exposed joints formed to exclude water.
- c. Before fabrication, obtain necessary field measurements and verify drawing dimensions.
- d. Clean metal surfaces free from mill scale, flake rust and rust pitting prior to shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

2.11 STRUCTURAL STEEL DOOR FRAMES

- a. Provide frames as indicated. If not otherwise shown, construct frames of structural shapes, or shape and plate composite, to form a full depth channel shape with at least 1 1/2 inch outstanding legs. For single swing doors, provide continuous 5/8 by 1 1/2 inch bar stock stops at head and jambs.
- b. Where track, guides, hoods, hangers, operators, and other such accessories are required, provide support as indicated.
- c. Provide jamb anchors near top, bottom, and at not more than 24 inch intervals. Provide the bottom of each jamb member with a clip angle welded in place with two 1/2 inch diameter floor bolts for adjustment.

PART 3 EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

3.2 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.3 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.6 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.7 HANDRAILS

3.7.1 Aluminum Handrail

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion shields or base plates or flanges bolted to stringers or structural steel framework. Provide Series 300 stainless steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, give the contact surface a heavy coating of bituminous paint.

3.8 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon floor.

3.9 ALUMINUM STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

-- End of Section --

SECTION 07214

BOARD AND BLOCK INSULATION

06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 272	(1991) Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 665	(1988) Fiberglass or Mineral Wool Batt Thermal Insulation with Kraft Paper Vapor-Resistant Membrane Laminated to One Side
ASTM C 930	(1992) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories.
ASTM D 1621	(1994) Compressive Properties of Rigid Cellular Plastics
ASTM D 3833	(1988; R 1993) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E 84	(1995; Rev. A) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 136	(1994; Rev. D) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 154	(1988; R 1993) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.134	Respiratory Protection
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FEDERAL SPECIFICATIONS (FS)

FS HH-I-1972/1	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil
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on Both Sides of the Foam

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(1996) National Electrical Code

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Block or board insulation
- b. Pressure sensitive tape
- c. Accessories

1.2.2 SD-06, Instructions

- a. Block or Board Insulation
- b. Adhesive

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board or block thermal insulation conforming to the following standards and the physical properties listed below:

- a. Rigid Foundation Insulation: Extruded Preformed Cellular Polystyrene: ASTM C 578
- b. Rigid Board Insulation: Aluminum Foil Faced Polyurethane or Polyisocyanurate Board: FS HH-I-1972/1
- c. Batt Thermal Insulation: Fiberglass or mineral wool batts, Type II, Class A, with 1 perm rating, nonreflective kraft paper vapor retarder: ASTM C 665.

2.1.1 Thermal Resistance

As indicated.

2.1.2 Fire Protection Requirement

- a. Flame spread index of 75 or less when tested in accordance with ASTM E 84.
- b. Smoke developed index of 200 or less when tested in accordance with ASTM E 84.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

- a. Compressive Strength: Not less than 30 psi when measured according to ASTM D 1621.
- b. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E 96, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.
- c. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C 272.

2.1.4 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section.

2.1.5 Prohibited Materials

Do not provide materials containing asbestos.

2.2 VAPOR RETARDER

2.2.1 Vapor Retarder under Floor Slab

- a. Water vapor permeance: 0.2 Perm or less when tested in accordance with ASTM E 96.

- b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E 154.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833.

2.4 ACCESSORIES

2.4.1 Adhesive

As recommended by insulation manufacturer.

2.4.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Unless using insulation board that passes ASTM E 136 in addition to the requirements in Part 2, install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

3.3 INSTALLATION

3.3.1 Insulation Board

Locate and install as indicated and handle insulation in accordance with the manufacturer's Installation Instructions. Keep material dry and free of extraneous materials. Observe safe work practices.

- a. Install extruded preformed cellular polystyrene insulation at foundation perimeter and under slab locations.
- b. Install aluminum foil faced polyurethane or polyisocyanurate board

insulation at masonry walls scheduled to be finished with gypsum wall board. Install aluminum foil facing to inside of room.

3.3.2 Batt Thermal Insulation

Locate and install as indicated and handle insulation in accordance with manufacturer's installation instructions. Keep material dry and free of extraneous materials. Install kraft paper vapor-resistant membrane to inside of room. Observe safe work practices.

3.3.3 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.5 Continuity of Insulation

Butt tightly against adjoining boards, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.4 INSTALLATION ON WALLS

3.4.1 Installation using Furring Strips

Install insulation between members as recommended by insulation manufacturer.

3.4.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant.

3.4.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

- a. Full back bed method or
- b. As recommended by the insulation manufacturer.
- c. Use only full back method for pieces of one square foot or less.
- d. Butt all edges of insulation and seal edges with tape.

3.4.4 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer.

After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.5 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade or floating-slab construction.

3.5.1 Manufacturer's Instructions

Install, attach, tape edges, provide vapor retarder and other requirements such as protection against vermin, insects, damage during construction as recommended in manufacturer's instructions.

3.5.2 Insulation on Vertical Surfaces

Install thermal insulation on interior face of foundation walls below grade and on edges of slabs on grade. Fasten insulation with adhesive or mechanical fasteners.

3.5.3 Insulation Under Slab

Provide insulation horizontally under slab on grade for a distance of 3 feet from the edge of slab. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.5.4 Protection of Insulation

Protect insulation on vertical surfaces from damage during construction and back filling by application of protection board or coating. Do not leave installed vertical insulation unprotected overnight. Install protection over entire exposed exterior insulation board.

3.6 VAPOR RETARDER

Apply a continuous vapor retarder as indicated. Overlap all joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07920

JOINT SEALANTS
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920

(1994) Elastomeric Joint Sealants

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Sealants
- b. Primers
- c. Bond breakers
- d. Backstops

Data for the sealants shall include shelf life, recommended cleaning solvents, and recommended installation.

1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 100 degrees F when sealant is applied.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 F degrees or less than 40 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Small voids between walls or partitions adjacent and built-in or surface-mounted equipment and fixtures, and similar items.	White
b. Perimeter of frames at doors, and which adjoin exposed interior concrete and masonry surfaces.	Color to match door and window frames
c. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Match adjacent surface
d. Behind escutcheon plates at valve pipe penetrations.	White

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames of doors and louvers adjoin metal building. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Color to match frames
b. Voids where items pass through exterior walls.	Match adjacent surface
c. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Gray

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH

JOINT DEPTH

Minimum

Maximum

For metal, glass, or other nonporous surfaces:

1/4 inch (minimum)
over 1/4 inch

1/4 inch
1/2 of
width

1/4 inch
Equal to
width

For concrete or masonry:

1/4 inch (minimum)
Over 1/4 inch to 1/2 inch

1/4 inch
1/4 inch

1/4 inch
Equal to
width

Over 1/2 inch to 2 inches

1/2 inch

5/8 inch

JOINT WIDTH

JOINT DEPTH

Minimum

Maximum

- b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

- a. Where indicated.
- b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.3 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.4 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.5 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08110

STEEL DOORS, DOOR FRAMES, AND WINDOW FRAMES
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM A 653/A 653M | (1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM C 591 | (1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| ASTM D 2863 | (1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index) |
| ASTM E 283 | (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM E 331 | (1993) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |

DOOR AND HARDWARE INSTITUTE (DHI)

- | | |
|---------------|---|
| ANSI/DHI A115 | (1991) Steel Door Preparation Standards |
|---------------|---|

STEEL DOOR INSTITUTE (SDI)

- | | |
|--------------|---|
| ANSI/SDI 100 | (1991) Standard Steel Doors and Frames |
| SDI 105 | (1992) Recommended Erection Instructions for Steel Frames |
| SDI 107 | (1984) Hardware on Steel Doors (Reinforcement - Application) |
| SDI 113 | (1979) Apparent Thermal Performance for Steel Door and Frame Assemblies |

STEEL WINDOW INSTITUTE (SWI)

- | | |
|---------|------------------------------------|
| SWI SWS | (1990) Steel Window Specifications |
|---------|------------------------------------|

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Doors
- b. Door Frames
- c. Window Frames
- d. Fasteners and Accessories
- e. Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door and frame and window frame construction, panel (internal) reinforcement, insulation, and door edge construction.

1.2.2 SD-04, Drawings

- a. Doors
- b. Door Frames
- c. Window Frames
- d. Accessories
- e. Weatherstripping

Show elevations, full size sections, construction details, metal gages, hardware provisions, elevation of window, method of glazing, method of anchoring, size and spacing of anchors, and installation details.

1.2.3 SD-07, Schedules

- a. Doors
- b. Door Frames
- c. Window Frame

Submit door, door frames and window frame locations.

1.2.4 SD-10, Test Reports

- a. Air infiltration
- b. Water infiltration

1.2.4.1 Test Reports of Air Infiltration and Water Infiltration

ASTM E 283 and ASTM E 331. Air infiltration shall not exceed one-half cubic foot per minute per foot of crack length when subjected to a static pressure of 1.56 pounds per square foot (equivalent to a wind velocity of 25 miles per hour (mph)). Water infiltration shall be zero.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI/SDI 100, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick.

2.1.1 Door Grades

2.1.1.1 Extra Heavy Duty Insulated Doors

ANSI/SDI 100, 16 gauge, Grade III, Model 3 with core construction Type a for interior doors and Type b, insulated core construction for exterior doors, of size(s) and design(s) indicated. Close top and bottom edges with steel channels not lighter than 16 gage. Prepare doors to receive hardware specified in Section 08710, "Door Hardware."

2.2 ACCESSORIES

2.2.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors.

2.2.2 Moldings

Provide moldings around glass of interior and exterior doors and interior window frame. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.3 INSULATION CORES

Insulated cores shall be of type specified, shall provide maximum assembly U-value of .48 in accordance with SDI 113 and shall conform to:

- a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863.

2.4 STANDARD STEEL DOOR FRAMES AND WINDOW FRAME

ANSI/SDI 100, except as otherwise specified. Form frames with welded corners; size shall be 2 inches deep by 6 inches wide, shape shall be

standard double rabbet. Provide 16 gauge steel frames for interior doors and window, and 14 gauge steel frames with thermal break for exterior doors.

2.4.1 Welded Door and Window Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.4.2 Transom Bars

Transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto. Provide manufacturer's standard 14 gage removable transom bar at door 101B.

2.4.3 Stops and Beads

Form stops and beads from 20-gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.4.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.6 WINDOW TYPE

Conform to SWI SWS. Provide fixed window type in size indicated. Window shall consist of a unit including frame, trim, glazing stop, and masonry anchors. Provide glazing as specified in Section 08800, "Glazing," and as indicated.

2.6 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

2.7 HARDWARE PREPARATION

Reinforce, drill, and tap doors and door frames to receive finish hardware. Prepare doors and door frames for hardware in accordance with the applicable requirements of SDI 107 and ANSI/DHI A115. Drill and tap for

surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI/SDI 100, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES

2.8.1 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior and interior doors, door frames, and window frame from galvanized steel, ASTM A 653/A 653M, Coating Designation G90. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI/SDI 100.

2.9 FABRICATION AND WORKMANSHIP

Finished doors, door frames, and window frame shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door and window frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Door and Window Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI/SDI 100. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors, door frames, and window from damage. Repair damaged doors, door frames, and window frame prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors, door frames, and window frame thoroughly. Remove mortar, paint spattering, mastic smears and other unsightly marks.

-- End of Section --

SECTION 08331

ROLLING SERVICE DOORS
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM A 123 | (1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 653/A 653M | (1994) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A 780 | (1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|------------|--|
| NEMA ICS 1 | (1993) Industrial Control and Systems |
| NEMA ICS 2 | (1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC |
| NEMA ICS 6 | (1993) Industrial Control and Systems Enclosures |
| NEMA MG 1 | (1993) Motors and Generators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|---------|---------------------------------|
| NFPA 70 | (1993) National Electrical Code |
|---------|---------------------------------|

UNDERWRITERS LABORATORIES INC. (UL)

- | | |
|--------|-------------------------------|
| UL 506 | (1994) Specialty Transformers |
|--------|-------------------------------|

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Rolling service doors
- b. Motors

c. Controls

For electrically operated system, submit wiring diagrams for motor and controls.

1.2.2 SD-04, Drawings

a. Rolling service doors G

Submit drawings for doors showing types, sizes, locations, metal gages, hardware provisions, installation details, and other details of construction. For motor-operated doors include supporting brackets for motors, location, type, and ratings of motors, and safety devices.

1.2.3 SD-06, Instructions

a. Rolling service doors

Submit manufacturer's currently recommended installation procedures for doors with the shop drawings.

1.2.4 SD-19, Operation and Maintenance Manuals

a. Rolling service doors

Submit Data Package 2, with wiring diagrams in accordance with Section 01781, "Operation and Maintenance Data."

1.3 DELIVERY AND STORAGE

Protect doors and accessories from damage during delivery, storage, and handling. Clearly mark manufacturer's brand name. Store doors in dry locations with adequate ventilation, free from dust and water, and in such a manner as to permit access for inspection and handling. Handle doors carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 PRODUCTS

2.1 ROLLING SERVICE DOORS

Shall be spring counterbalanced, rolling type, and shall be designed for use on exterior openings, as indicated. Doors shall be operated by electric-power with emergency auxiliary hand chain operation. Doors shall be complete with guides, hardware, fastenings, operating mechanisms, and accessories. Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to provide a clear opening when door is in open position. Doors, hardware, and anchors shall be designed to withstand wind pressures in accordance with MIL-HDBK-1002/2A, Basic Wind Speed of 80 mph and Importance Factor of 1.0 without damage. Exterior doors shall be mounted on interior side of walls.

2.2 FABRICATION

2.2.1 Curtains

Shall be formed of interlocking galvanized steel slats of shapes standard with the manufacturer, except that slats for exterior doors shall be flat

type. Curtain shall roll up on a barrel supported at head of opening on brackets and be balanced by a torsional spring system in the barrel. Slats for doors less than 15 feet wide shall be not lighter than 22 gage. Slats shall be of the gage required for the width indicated and the wind pressure specified above. Slats for exterior doors shall be insulated with not less than 1/2 inch thick polyurethane or polyisocyanurate foam insulation. Interior side of insulation shall be covered with interlocking galvanized steel slats not lighter than 24 gage.

2.2.2 Endlocks and Windlocks

The ends of each slat or each alternate slat shall have malleable iron or galvanized steel endlocks of manufacturer's stock design. In addition to endlocks, exterior doors shall have windlocks or integral slat lugs of manufacturer's standard design at ends of at least every sixth slat. Windlocks or lugs shall prevent curtain from leaving guide because of deflection from wind pressure or other forces.

2.2.3 Bottom Bar

The curtain shall have a steel bottom bar consisting of two angles of equal weight, one on each side, or an equivalent extruded aluminum section, fastened to bottom of curtain. In addition, exterior doors shall have a compressible and replaceable rubber, neoprene, or vinyl weather seal attached to bottom bar.

2.2.4 Guides

Steel structural shapes or formed steel shapes fastened to wall with steel shapes not less than 3/16 inch thick. Guides shall be of sufficient depth or shall incorporate a steel locking bar to retain the curtain in place under the wind pressure specified. Provide continuous vinyl or neoprene weather seals on guides at exterior doors. Securely attach guides to adjoining construction with not less than 3/8 inch diameter bolts, spaced near each end and not over 30 inches apart.

2.2.5 Barrel

Steel pipe or commercial welded steel tubing of proper diameter and thickness for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Close ends of barrel with cast-iron plugs, machined to fit the pipe and either pinned or attached with screws in the spring barrel, except that drive end plug may be steel welded in place. Welding shall not be used on the tension end. Install within the barrel an oil-tempered, stress relieved, helical, counterbalancing steel spring, capable of producing sufficient torque to assure easy operation of the door curtain from any position. At least 80 percent of the door weight shall be counterbalanced at any position. Spring-tension shall be adjustable without removing the hood.

2.2.6 Brackets

Fabricate of steel plate or heavy cast iron to support the barrel, curtain, and operator and to form a supporting ring and end closure for the hood. Provide prelubricated, self-aligning ball bearings, shielded or sealed.

2.2.7 Hoods

Steel, not lighter than 24 gage formed to fit contour of end brackets and

reinforced with steel rods, or rolled beads at top and bottom edges.

2.3 ELECTRIC OPERATION

2.3.1 Operator Features

Provide operators complete with electric motor, machine-cut reduction gears, steel chain and sprockets, magnetic brake, overload protection, brackets, pushbutton controls, limit switches, magnetic reversing contactor, and other accessories necessary for proper operation. The operator shall be so designed that the motor may be removed without disturbing the limit-switch timing and without affecting the emergency auxiliary operators. Make provision for immediate emergency manual operation of door by chain-gear mechanism in case of electrical failure. The emergency manual operating mechanism shall be so arranged that it may be put into and out of operation from the floor, and its use shall not affect the timing of the limit switches. Provide an electrical or mechanical device which will disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.3.2 Motors

Shall conform to NEMA MG 1, high-starting torque, reversible type of sufficient horsepower and torque output to move the door in either direction from any position, and produce a door travel speed of not less than two-thirds foot or more than one foot per second, without exceeding the rated capacity. Motors shall be suitable for operation on current of the characteristics indicated and shall operate at not more than 3600 rpm. Single-phase motors shall not have commutation or more than one starting contact. Install motors in approved locations. Maximum motor size 1/2 HP.

2.3.3 Controls

Each door motor shall have an enclosed, across-the-line type, magnetic reversing contactor, thermal-overload protection, solenoid-operated brake, limit switches, and remote control switches at locations indicated. Remote control switches shall be at least 5 feet above the floor line, and all switches shall be located so that the operator will have complete visibility of the door at all times. The control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Control enclosures shall be NEMA ICS 6, Type 12 or Type 4, for interior locations and Type 4 for exterior locations, except that contactor enclosures may be Type 1. Locate control switches inside the building unless otherwise indicated. Each switch control station shall be of the three-button type, with the buttons marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons shall be of the type requiring only momentary pressure to operate. The "CLOSE" button shall be of the type requiring constant pressure to maintain the closing motion of the door. When the door is in motion, and the "STOP" button is pressed or the "CLOSE" button released, the door shall stop instantly and remain in the stop position; from the stop position, the door may then be operated in either direction by the "OPEN" or "CLOSE" buttons. Pushbuttons shall be full-guarded to prevent accidental operation. Provide limit switches to automatically stop the doors at their fully open and closed positions. Positions of the limit switches shall be readily adjustable.

2.3.4 Safety Device

The bottom bar of power-operated doors shall have a safety device that will immediately stop and reverse the door in its closing travel upon contact

with an obstruction in the door opening or upon failure of the device or any component of the control system and cause the door to return to its full open position. The door-closing circuit shall be automatically locked out and the door shall be operable manually until the failure or damage has been corrected. Do not use safety device as a limit switch.

2.3.5 Control Transformer

Shall be provided in power circuits as necessary to reduce the voltage on the control circuits to 120 volts or less (preferably 24 volts). The transformer shall conform to UL 506.

2.3.6 Electrical Work

Electrical components and installation shall conform to NFPA 70. The door manufacturer shall furnish manual or automatic control and safety devices, including extra flexible type SO cable and spring-loaded automatic takeup reel or equivalent device, as required for proper operation of the doors. Conduit, wiring, and mounting of controls is specified in Section 16402, "Interior Distribution System."

2.4 FINISHES

Slats, steel bottom bars, and hoods shall be hot-dip galvanized and shop primed. Shop prime other parts of coiling doors, except faying surfaces.

2.4.1 Primed Finish

Clean surfaces thoroughly, treat to assure maximum paint adherence, and provide a factory dip or spray coat of rust-inhibitive metallic oxide or synthetic resin primer on exposed surfaces.

2.4.2 Galvanized and Shop-Primed Finish

Surfaces specified shall have a zinc coating, a phosphate treatment, and a shop prime coat of rust-inhibitive paint. The galvanized coating shall conform to ASTM A 653/A 653M, coating designation G90, for steel sheets, except that hoods located on interior of the building may be G60, and ASTM A 123 for iron and steel products. The weight of coatings for products shall be as designated in Table I of ASTM A 123 for the thickness of base metal to be coated. The prime coat shall be a type especially developed for materials treated by phosphates and adapted to application by dipping or spraying. Repair damaged zinc-coated surfaces by the materials and methods conforming to ASTM A 780 and spot prime. At the option of the Contractor, a two-part system including bonderizing, baked-on epoxy primer, and baked-on enamel top coat may be applied to slats before forming, in lieu of prime coat specified.

PART 3 EXECUTION

3.1 INSTALLATION

Install doors in accordance with approved detail drawings and manufacturer's directions. Locate anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories accurately. Upon completion, doors shall be weathertight and shall be free from warp, twist, or distortion.

3.2 FINAL ADJUSTMENT

Doors shall be lubricated and properly adjusted to operate freely.

-- End of Section --

SECTION 08710

DOOR HARDWARE
03/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283

(1991) Rate of Air Leakage Through
Exterior Windows, Curtain Walls, and Doors
Under Specified Pressure Differences
Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.1

(1988) Butts and Hinges (BHMA 101)

ANSI/BHMA A156.3

(1989) Exit Devices (BHMA 701)

ANSI/BHMA A156.4

(1992) Door Controls - Closers

ANSI/BHMA A156.6

(1994) Architectural Door Trim (BHMA 1001)

ANSI/BHMA A156.7

(1988) Template Hinge Dimensions

ANSI/BHMA A156.13

(1987) Mortise Locks & Latches (BHMA 621)

ANSI/BHMA A156.15

(1986) Closer Holder Release Devices (BHMA
321)

ANSI/BHMA A156.16

(1989) Auxiliary Hardware (BHMA 1201)

ANSI/BHMA A156.18

(1993) Materials and Finishes (BHMA 1301)

ANSI/BHMA A156.21

(1989) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101

(1994) Code for Safety to Life from Fire
in Buildings and Structures

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100

(1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD

(1994) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Hardware items G

1.2.2 SD-06, Instructions

- a. Installation

1.2.3 SD-07, Schedules

- a. Hardware schedule
- b. Keying system. Prior to selecting keying system, coordinate with the Activity Officer, the Base Locksmith, and the Contracting Officer.

1.2.3.1 Hardware Schedule

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference Publi- cation Type No.	Finish	Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	ANSI/BHMA Finish Designa- tion
-----	-----	-----	-----	-----	-----	-----	-----	-----

1.2.4 SD-18, Records

- a. Key bitting

1.2.4.1 Chart Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- a. Complete listing of all keys (AA1, AA2, etc.).
- b. Complete listing of all key cuts (AA1-123456, AA2-123458).
- c. Tabulation showing which key fits which door.
- d. Copy of floor plan showing doors and door numbers.
- e. Listing of 20 percent more key cuts than are presently required in each master system.

1.2.5 SD-19, Operation and Maintenance Manuals

- a. Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

1.3 QUALITY ASSURANCE

1.3.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL BMD or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

ANSI/BHMA A156.1, 4 1/2 by 4 1/2 inches. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed.

2.3.2 Locks and Latches

2.3.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2 1/4 inches with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Levers and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.3 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type

devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars may be provided in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2 1/4 inches.

2.3.4 Cylinders and Cores

Provide cylinders for new locks, including locks provided under other sections of this specification. Cylinders shall be fully compatible with products of the best lock corporation and shall have interchangeable cores that are removable by a special control key. Cores shall have seven pin tumblers and shall be factory tested using the A4 system and F key way. Submit a core code sheet with cores. The cores shall be master keyed in one system for this project. Provide construction interchangeable cores.

2.3.5 Keying System

Provide a master keying system. Coordinate keying system with Activity Officer, Base Locksmith, and Contracting Officer.

2.3.6 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.6.1 Lever Handles

Provide lever handles in lieu of knobs. Lever handles for exit devices shall meet the test requirements of ANSI/BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 1/2 inch of the door face.

2.3.7 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.8 Door Bolts

ANSI/BHMA A156.16. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.3.9 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.9.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of

manufacture, and manufacturer's size designation located to be visible after installation.

2.3.10 Closer Holder-Release Devices

ANSI/BHMA A156.15.

2.3.11 Door Protection Plates

ANSI/BHMA A156.6.

2.3.11.1 Sizes of Kick Plates

Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 10 inches for flush doors and one inch less than height of bottom rail for panel doors.

2.3.12 Door Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.13 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.14 Weather Stripping

A set shall include head and jamb seals and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Install weather stripping at all doors. Weather stripping shall be one of the following:

2.3.14.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be dark bronze anodized.

2.3.14.2 Interlocking Type

Bronze not less than 0.018 inch thick.

2.3.15 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, dark bronze anodized. Set drips in sealant conforming to Section 07920, "Joint Sealants," and fasten with stainless steel screws.

2.3.15.1 Overhead Rain Drips

Approximately 1 1/2 inches high by 2 1/2 inches projection, with length equal to overall width of door frame. Align bottom with door frame rabbet. Provide at each exterior door.

2.3.16 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jams and flexible hook type at sills. Nail weather stripping to door one inch o.c. and to heads and jams at 4 inches o.c.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 EXIT DOORS

Install hardware in accordance with NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

ANSI/SDI 100, unless indicated or specified otherwise.

- a. Kick Plates: Push side of single-acting doors.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS (HW)

HW-1

1-1/2 Pair Hinges	A5112 x 630
1 Exit Device with Exterior Trim	Type 1, 11 x 630
1 Closure with Holder-Release Device	C02021
1 Threshold	Type 26
1 Set Weatherstripping	As specified
1 Kick Plate (mount on inside face of door)	

HW-2

3 Pair Hinges	A5112 x 630
1 Entrance Lockset	F12, F13
1 Closure with Holder-Release Device	C02021
1 Bolt	Inactive Leaf Only
1 Threshold	Type 26
1 Kick Plate (mount on inside face of active leaf)	As specified
1 Set Weatherstripping	As specified

HW-3

All hardware by overhead rolling door manufacturer (OHR)

HW-4

1-1/2 Pair Hinges	A5112 x 630
1 Latchset	F01
1 Closure	C02021
2 Kick Plates	As specified
1 Set Weatherstripping	As specified

HW-5

1-1/2 Pair Hinges	A5112 x 630
1 Privacy Lockset	F19, F22
2 Kick Plates	As specified
1 Set Weatherstripping	As specified

-- End of Section --

SECTION 08800

GLAZING
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM C 1036	(1991) Flat Glass
ASTM C 1048	(1992) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM E 774	(1992) Sealed Insulating Glass Units

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201	Safety Standard for Architectural Glazing Materials
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GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA GM	(1990) Glazing Manual
GANA SM	(1990) Sealant Manual

SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SIGMA)

SIGMA A1202	(1983) Commercial Insulating Glass Dimensional Tolerances
SIGMA TM-3000	(1990) Vertical and Basic Field Glazing of Organically Sealed Insulating Glass Units
SIGMA TB-3001	(1990) Sloped Glazing of Organically Sealed Insulating Glass Units

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-06, Instructions

- a. Setting and sealing materials
- b. Glass setting

Submit glass manufacturer's recommendations for setting and sealing

materials and for installation of each type of glazing material specified.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.5 WARRANTY

1.5.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 5-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

PART 2 PRODUCTS

2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, 1/4 inch thick.

2.2 INSULATING GLASS UNITS

Made up of two panes of tempered glass separated by a 1/2 inch dehydrated airspace, hermetically sealed. Provide clear glass inboard and light solar bronze glass outboard at exterior applications. Provide clear glass inboard and outboard at interior applications. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E 774, Class A.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA GM, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant shall be white.

2.3.2 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.3 Setting Blocks and Edge Blocks

Lead or neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

2.3.4 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA A1202, SIGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA A1202, SIGMA TM-3000, and manufacturer's recommendations. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA

TM-3000.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

-- End of Section --

SECTION 09250

GYPSUM BOARD
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 36	(1995; Rev. B) Gypsum Wallboard
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 840	(1995) Application and Finishing of Gypsum Board
ASTM C 1002	(1993) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM C 1047	(1995) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1178	(1995) Glass Mat Water-Resistant Gypsum Backing Board

GYPSUM ASSOCIATION (GA)

GA 216	(1993) Application and Finishing of Gypsum Board
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1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Accessories

Submit for each type of gypsum board.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

PART 2 PRODUCTS

2.1 MATERIALS

Shall conform to the respective specifications and standards and to the requirements specified herein. Provide gypsum board manufactured from asbestos-free materials.

2.1.1 Gypsum Board

ASTM C 36.

2.1.1.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.2 Water-Resistant Gypsum Backing Board

ASTM C 1178.

2.1.2.1 Regular

48 inches wide, 5/8 inch, tapered edges.

2.1.3 Joint Treatment Materials

ASTM C 475.

2.1.3.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.3.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.3.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.3.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.3.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.4 Fasteners

2.1.4.1 Screws

ASTM C 1002, Type "S" steel drill screws for fastening gypsum board to gypsum board, and steel furring members less than 0.033 inch thick.

2.1.5 Adhesives

Adhesive containing benzene, carbon tetrachloride, or trichloroethylene shall not be used.

2.1.5.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by the gypsum board manufacturer.

2.1.6 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for its intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect the bond of joint treatment.

2.1.7 Water

Clean, fresh, and potable.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Furring

Verify that furring is securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive grab bars, toilet accessories, and similar items. Do not proceed with work until furring is acceptable for application of gypsum board units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840 or GA 216. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

3.3.1 Skim Coat

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, apply a thin skim coat of joint compound to the entire gypsum board surface, after the three-coat joint and fastener treatment is complete and dry. Apply skim coat with trowel, broadknife or long-nap roller. Wipe tightly with trowel or broadknife.

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board as specified in Section 07920, "Joint Sealants." Apply material with exposed surface flush with gypsum board.

3.5 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

-- End of Section --

SECTION 09900

PAINTS AND COATINGS
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH TLV-BKLT (1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)

ACGIH TLV-DOC Documentation of Threshold Limit Values and Biological Exposure Indices, Sixth Edition

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2092 (1986; R 1993) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting

ASTM D 4263 (1983; R 1993) Indicating Moisture in Concrete by the Plastic Sheet Method

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1500 (Rev. A) Sealer, Surface (Latex Block Filler)

CID A-A-1558 (Rev. A) Paint, Stencil

FEDERAL STANDARDS (FED-STD)

FED-STD-313 (Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

FEDERAL SPECIFICATIONS (FS)

FS TT-P-19 (Rev. D; Am. 1) Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)

FS TT-E-489 (Rev. J) Enamel, Alkyd, Gloss, Low VOC Content

FS TT-P-645 (Rev. B) Primer, Paint, Zinc-Molybdate, Alkyd Type

FS TT-P-650 (Rev. D) Primer Coating, Latex Base,

	Interior, White (for Gypsum Wallboard or Plaster)
FS TT-P-1511	(Rev. B) Paint, Latex (Gloss and Semigloss, Tints and White) (for Interior Use)
FS TT-E-1593	(Rev. B) Enamel, Silicone Alkyd Copolymer, Gloss (For Exterior and Interior Use)
FS TT-P-002119	Paint, Latex-Base, High-Traffic Area, Flat and Eggshell Finish (Low Lustre), (for Interior Use)

MILITARY SPECIFICATIONS (MIL)

MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-C-24667	(Rev. A) Coating System, Nonskid, for Roll or Spray Application (Metric)
MIL-P-28577	(Rev. B) Primer, Water-Borne, Acrylic or Modified Acrylic, for Metal Surfaces
MIL-P-28578	(Rev. B) Paint, Water-Borne, Acrylic or Modified Acrylic, Semigloss, for Metal Surfaces
MIL-C-85285	(Rev. B; Am. 2) Coatings: Polyurethane, High-Solids

MILITARY STANDARDS (MIL-STD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders
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STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PA 1	(1991) Shop, Field, and Maintenance Painting
SSPC PA 3	(1991) Safety in Paint Application
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1989) Hand Tool Cleaning
SSPC SP 3	(1989) Power Tool Cleaning
SSPC SP 6	(1991) Commercial Blast Cleaning
SSPC SP 7	(1991) Brush-Off Blast Cleaning
SSPC SP 10	(1991) Near-White Blast Cleaning

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturers Catalog Data

- a. Coating G
- b. Sealant

1.2.1.1 Requirements

For each type of coating, sealant, or other product furnished:

- a. Submit data from the manufacturer's paint laboratory indicating that the product conforms to requirements of the referenced specification.

1.2.2 SD-06, Instructions

- a. Application instructions
- b. Manufacturer's material safety data sheets

Submit Manufacturer's material safety data sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.2.3 SD-07, Schedules

- a. Piping identification

Submit color stencil codes.

1.2.4 SD-08, Statements

- a. Evidence of acceptable variation G

1.2.4.1 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence from the paint manufacturer's laboratory that the proposed product is either equal to or better than the product specified. The submittal shall include the following:

- a. Identification of the proposed substitute;
- b. Reason why the substitution is necessary;
- c. A comparative analysis of the specified product and the proposed substitute, including tabulations of the composition of pigment and vehicle;
- d. The differences between the specified product and the proposed substitute; and
- e. Other information necessary for an accurate comparison of the proposed substitute and the specified product.

1.2.5 SD-14, Samples

a. Color G

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Airless Spray Applicators

Satisfactory application of paint by airless spray at a minimum of two sites.

1.3.2 Field Samples and Tests

The Government will take one pint samples of paint at random from the products delivered to the job site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from the job site and replaced with new products that conform to the referenced specification or the approved substitution.

1.4 REGULATORY REQUIREMENTS

1.4.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District having regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform to Air Quality Management District Rules (cited in Appendix A) for the location of the project. In localities where specified coating or paint is prohibited, the Contracting Officer may direct substitution of acceptable coating system.

1.4.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.4.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.4.4 Asbestos Content

Materials shall not contain asbestos.

1.4.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.4.6 Silica Sand

The use of silica sand is prohibited.

1.4.7 Human Carcinogens

Materials shall not contain ACGIH TLV-BKLT and ACGIH TLV-DOC confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.5 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.6 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with the following:

1.6.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.6.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The chemical manufacturer when using mineral spirits, or other chemicals. Use impermeable gloves, chemical goggles or faceshield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.

1.7 ENVIRONMENTAL CONDITIONS

1.7.1 Exterior Coatings

Do not apply coating to surfaces during foggy or rainy weather, or under the following surface temperature conditions:

- a. Less than 5 degrees F above dew point;
- b. Below 40 degrees F (for oil-based paints), 50 degrees F (for latex paints or over 95 degrees F), unless approved by the Contracting Officer.

1.7.2 Interior Coatings

Apply coatings when surfaces to be painted are dry and the following surface temperatures can be maintained:

- a. Between 65 and 95 degrees F during application of enamels and varnishes;

- b. Between 50 and 95 degrees F during application of other coatings.

1.8 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, brass, and lead.

1.9.3 Exterior Painting

Includes new surfaces of the building and appurtenances as indicated.

1.9.4 Interior Painting

Includes new surfaces of the building and appurtenances as indicated. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, miscellaneous structural metal components and
- b. Other contiguous surfaces.

1.9.5 Exterior Painting of Site Work Items

Field coat the following items or areas:

- a. New Surfaces: As shown on Exterior Finish Schedule on Drawing A-5.

1.9.6 Tank and Equipment Painting and Coating

Refer to process equipment, tank, and other related specifications for manufacturer required painting and coatings.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the specifications and standards referenced in PART 3.

2.1.1 Latex Block Filler

CID A-A-1500.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other substances deleterious to coating performance as specified for each substrate.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Ferrous Surfaces

- a. Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 6. Brush-off blast remaining surface in accordance with SSPC SP 7. Use inhibitor as recommended by coating manufacturer to prevent premature rusting.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6.

3.3.2 Final Ferrous Surface Condition:

Cleaned surface shall be similar to photographs in SSPC VIS 1 as follows:

Degree of Cleaning	100% Adherent Mill Scale	Mill Scale and Rust	100% Rust	100% Rust with Pits
Hand Tool Cleaning SSPC SP 2	(1)	B St 2	C St 2	D St 2
Power Tool Cleaning SSPC SP 3	(1)	B St 3	C St 3	D St 3
Commercial Blast Cleaning SSPC SP 6	**	B SP 6	C SP 6	D SP 6
Brush-Off Blast Cleaning SSPC SP 7	*	B SP 7	C SP 7	D SP 7
Near White Blast Cleaning SSPC SP 10	A SP 10	B SP 10	C SP 10	D SP 10

Note: (1) No photograph is available or recommended for comparison.

* Standard photograph not provided because of wide variations in appearance possible when brush-off blast cleaning adherent mill scale.

** No photograph available because this condition cannot normally be attained when removing adherent mill scale.

3.3.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast or other treatment, or the surface shall be primed with a primer which is specifically recommended by the paint manufacturer for use on passivated or stabilized galvanized steel. For new galvanized steel to be coated, if absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

3.3.4 Aluminum, Other Non-Galvanized, and Non-Ferrous Surfaces

- a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

- a. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

- b. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

- a. Surface Cleaning: Gypsum board shall be dry, clean and free from loose matter. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.
- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum instrument measured moisture content of 8 percent. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 APPLICATION

3.5.1 Coating Application

Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein. Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied while the intermediate coat is still tacky, within a few days. Otherwise, apply a mist-coat of 1 to 2 wet mils of MIL-P-24441/20 and allow to cure to tack, a minimum of 4 hours, before topcoating.
- e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.5.2 Equipment

Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

3.5.3 Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

3.5.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

1	Exterior Metal Surfaces
2	Interior Metal Surfaces
3	Building Systems Surfaces: Interior and Exterior
4	Exterior Concrete
5	Interior Concrete, Concrete Masonry, and Wallboard Surfaces

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness. The DFT range specified for MIL-C-24667 represents minimum peak and valley measurements.

- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
 - (1) One coat of primer.
 - (2) One coat of undercoat or intermediate coat.
 - (3) One topcoat to match adjacent surfaces.

3.6 COATING SYSTEMS FOR METAL

- a. Primer: Apply specified ferrous metal primer on the same day that surface is cleaned. If flash rusting occurs, re-clean the surface prior to application of primer.
 - (1) Inaccessible Surfaces: Prior to erection, use two coats of specified primer on metal surfaces that will be inaccessible after erection.
 - (2) Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
 - (4) Pipes and Tubing: Semitransparent film applied to pipes and tubing at the mill is not to be considered a shop coat. Apply specified ferrous metal primer prior to application of subsequent coats.
 - (5) Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer, MIL-P-28577.
- b. Apply coatings of Tables 1, 2 and 3. "DFT" means dry film thickness in mils.

3.7 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow. Use black stencil paint, CID A-A-1558.

3.8 FIELD QUALITY CONTROL

The Government will take one-pint samples of paint at random from the products delivered to the job site, and test samples to verify that products either conform to referenced specifications or the approved substitution. Products which do not conform shall be removed from the job site and replaced with new products that conform to referenced specifications or the approved substitution.

3.9 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

TABLE 1

EXTERIOR METAL SURFACES (FERROUS)

- A. New exposed steel that has been blast cleaned up to SSPC SP6, System No. 5 Exposed Metal Mildly Corrosive:

Primer:	MIL-P-24441 /1 Formula 150 Type 1	3.0 mils DFT
Intermediate:	MIL-P-24441 /3 Formula 152 Type II	3.0 mils DFT
Topcoat:	MIL-C-85285 Type II	3.0 mils DFT

- B. New steel blasted to SSPC SP 10:

Primer:	MIL-P-24441 /1 Formula 150 Type 1	3.0 mils DFT
Intermediate:	MIL-P-24441 /1 Formula 152 Type II	3.0 mils DFT
Topcoat:	FS TT-P-19	2.0 mils DFT (or)
	MIL-P-28578	2.0 mils DFT

EXTERIOR METAL SURFACES (GALVANIZED)

- C. New Galvanized Surfaces:

Primer:	CID A-A-50557	1.5 mils DFT
Intermediate:	FS TT-E-489	1.5 mils DFT
Topcoat:	FS TT-E-1593	1.5 mils DFT

- D. Galvanized surfaces with slight coating deterioration; little or no rusting:

Spot Prime:	MIL-P-24441 /1 Formula 150 Type I	3.0 mils DFT
Intermediate:	N/A	
Topcoat:	MIL-C-85285	2.0 mils DFT

TABLE 2

INTERIOR METAL SURFACES

- A. System No. 5 Exposed Metal Mildly Corrosive:

Primer:	MIL-P-24441/1 Formula 150 Type I	3.0 mils DFT
Intermediate:	MIL-P-24441/3 Formula 152 Type II	3.0 mils DFT
Topcoat:	MIL-C-85285 Type I	3.0 mils DFT

TABLE 3

BUILDING SYSTEMS SURFACES: INTERIOR AND EXTERIOR

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

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Mechanical, electrical, hangers, supports, exposed piping, and miscellaneous metal items, except hot metal surfaces and new prefinished equipment:

A. System No. 6 Exposed Metal-Atmospheric:

Primer:	FS TT-P-645	2.0 mils DFT
Intermediate:	FS TT-E-489	1.5 mils DFT
	FS TT-E-1593	1.5 mils DFT
Topcoat:	FS TT-E-489	1.5 mils DFT
	FS TT-E-1593	1.5 mils DFT

TABLE 4

EXTERIOR CONCRETE AND CONCRETE MASONRY SURFACES

A. System No. 22 Chemical-Resistant Coating:

Primer:	CID A-A-1500	1 coat, as required to fill voids
Intermediate:	MIL-P-24441	1 coat, 160 square feet per gallon
	(High Build)	
Topcoat:	MIL-P-24441	1 coat, 160 square feet per gallon
	(High Build Gloss)	

B. System No. 112 New Concrete:

Intermediate:	FS TT-P-19	1 coat, 240 square feet per gallon
Topcoat:	FS TT-P-19	1 coat, 240 square feet per gallon

TABLE 5

INTERIOR CONCRETE, CONCRETE MASONRY, AND WALLBOARD SURFACES

A. System No. 22 Chemical-Resistant Coating, New Concrete:

Primer:	CID A-A-1500	1 coat, as required to fill voids
Intermediate:	MIL-P-24441	1 coat, 160 square feet per gallon
	(High Build)	
Topcoat:	MIL-P-24441	1 coat, 160 square feet per gallon
	(High Build Gloss)	

B. System No. 112 Concrete not specified otherwise, except floors (semi-gloss):

Primer:	FS TT-P-19	1 coat, 240 square feet per gallon
Intermediate:	N/A	
Topcoat:	FS TT-P-19	1 coat, 240 square feet per gallon

C. System No. 109 Concrete Masonry Eggshell:

Primer:	CID A-A-1500	1 coat, 75 square feet per gallon minimum, fill all holes in masonry surfaces
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Intermediate:	FS TT-P-002119 Class 2	240 square feet per gallon
Topcoat:	FS TT-P-002119 Class 2	240 square feet per gallon

TABLE 5

INTERIOR CONCRETE, CONCRETE MASONRY, AND WALLBOARD SURFACES

D. System No. 114, Wallboard not otherwise specified:

Primer:	FS TT-P-650	1 coat, 350 square feet per gallon
Intermediate:	FS TT-P-1511 semigloss	1 coat, 120 square feet per gallon
Topcoat:	FS TT-P-1511 semigloss	1 coat, 120 square feet per gallon

E. System No. 115, Wallboard in Toilets:

Primer:	FS TT-P-650	1 coat, 350 square feet per gallon
Intermediate:	FS TT-E-509	1 coat, 200 square feet per gallon
Topcoat:	FS TT-P-509	1 coat, 200 square feet per gallon

-- End of Section --

SECTION 10400

IDENTIFICATION DEVICES

09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45 (1980) Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.3 (1995) Power-Actuated Fastening Systems

ANSI B18.2.1 (1981; R 1992) Square and Hex Bolts and Screws Inch Series

ANSI B18.6.1 (1981; R 1991) Wood Screws (Inch Series)

ANSI B18.6.2 (1972; R 1993) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws

ANSI B18.6.3 (1972; R 1991) Machine Screws and Machine Screw Nuts

ANSI B18.7 (1972; R 1992) General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets and Rivet Caps

ANSI Z 535.1 (1991/1997) Safety Color Code

ANSI Z 535.2 (1991/1997) Environmental and Facilities Safety Signs

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 653/A 653M (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM D 3841 (1992) Glass-Fiber-Reinforced Polyester Plastic Panels

ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)

ATBCB ADA TITLE III

(1990) Americans with Disabilities Act -
Buildings and Facilities

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1

(1996) Structural Welding Code Steel

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Exterior post and panel signs
- b. Interior room and direction plaque signs

1.2.2 SD-04, Drawings

- a. Exterior post and panel signs
- b. Interior room and direction plaque signs
- c. Pressure sensitive vinyl safety signs.
- d. Fibre-reinforced polyester safety signs.

Submit complete detail drawings, templates, erection and installation details for products listed below. Indicate dimensions, construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.2.3 SD-14, Samples

- a. Exterior post and panel signs, frame and post G
- b. Interior room, door, plaque signs G
- c. Pressure sensitive vinyl safety signs. G
- d. Fibre-reinforced polyester safety signs. G

Take samples from manufacturer's stock complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

PART 2 PRODUCTS

Sign characteristics and message content shall be as scheduled following "End of Section."

2.1 FIBER-REINFORCED POLYESTER (TYPE A)

ASTM D 3841, Type II, Grade 1, ANSI Z 535.1, ANSI Z 535.2, color: As indicated.

Sign characteristics, message content, and color shall be as scheduled following "End of Section."

2.2 PRESSURE-SENSITIVE (TYPE B)

ANSI Z 535.1, ANSI Z 535.2, fade resistant, non-removable, flexible, pressure-sensitive vinyl with strong adhesive backing, minimum 4-mil thickness. Suitable for use outside. Sign characteristics, message content, and color shall be as scheduled following "End of Section."

2.3 EXPOSED ANCHORS AND FASTENERS

Compatible with sign material to which applied with matching color and finish. Protect against galvanic action or chemical interaction of adhesives.

2.3.1 Expansion Shields

Shields shall be recessed not less than 2 1/2 inches into concrete or masonry.

2.3.2 Lag Screws and Bolts

ANSI B18.2.1.

2.3.3 Bolts, Nuts, Studs, and Rivets

ANSI B18.2.1 or ANSI B18.7.

2.3.4 Powder Driven Fasteners

When permitted by ANSI A10.3. Follow safety provisions of ANSI A10.3.

2.3.5 Screws

ANSI B18.2.1, ANSI B18.6.1, ANSI B18.6.2, and ANSI B18.6.3.

2.4 FABRICATION AND MANUFACTURE

2.4.1 Workmanship

For bolts and screws, drill or punch holes to produce clean, true lines and surfaces. Weld to structural steel in accordance with AWS D1.1 along entire area of contact. Grind exposed welds smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Conceal fastenings where practicable. Items specified to be galvanized shall be hot-dip galvanized after fabrication in accordance with ASTM A 123 or ASTM A 153/A 153M or ASTM A 653/A 653M. Form joints exposed to weather to exclude water. Include drainage and weep holes to prevent build-up of condensation.

2.4.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, protect surfaces with two coats of epoxy primer at 3.0 mils dry film thickness (DFT) each coat and finish with one coat of latex paint at 2.0 mils DFT to prevent galvanic or corrosive action.

2.4.3 Shop Painting

Apply an approved rust-resisting treatment and primer in accordance with manufacturer's standard practice to surfaces of miscellaneous metal work, except non-ferrous metal, corrosion-resisting steel, and zinc-coated work. Do not paint surfaces of items to be embedded in concrete. Upon completion of work, thoroughly recoat damaged surfaces. Prime coat steelwork immediately after cleaning.

2.5 EXTERIOR POST AND PANEL SIGNS

2.5.1 Posts

Provide one-piece extruded aluminum posts 2 1/2 inches by 2 1/2 inches with minimum 0.125 inch wall thickness. Design post extrusion to accept panel framing system described herein. Design posts to permit attachment of panel framing system without exposed fasteners. Provide cap for each post, matching design, material and color of the post.

2.5.2 Finishes

2.5.2.1 Post Finish

Baked enamel AA 45, designation AA-M21C22A42.

2.5.3 Colors

a. Posts: Brown.

2.5.4 Mounting

Provide permanent mounting by embedding posts in concrete foundation. Concrete is specified in Section 03300, "Cast-In-Place Concrete".

2.5.5 Silkscreened Images

Apply message to panel using the silkscreen process. Execute silkscreened images with photo screens prepared from original art. No handcut screens will be accepted. Original art shall be defined as artwork that is a first generation reproduction of the specified art. Clean edges and corners. Rounded corners, cut or ragged edges, edge build-up, bleeding or surface pinholes will not be accepted.

2.5.6 Cutout Recessed Letters

Cut out message letters from panel. Back up panel with 0.125 inch acrylic where cutouts occur.

2.5.7 FRP Embedded Letters

Embed message in FRP sheet and completely cover with thermosetting polyester resin. Embed message minimum 1/32 inch. Process sheets in one piece, in one process, to prevent delamination.

2.12 PRESSURE-SENSITIVE VINYL

Ensure that edges and corners of finished sign are true and clean. Corners shall be square; do not use rounded positive or negative corners, nicked,

cut, or ragged edges.

2.6 INTERIOR PLAQUE SIGNS

ATBCB ADA TITLE III. Provide matte finish plaques. Fabricate of melamine plastic, 1/8 inch thick. Provide square corners.

2.6.1 Graphics Application

2.6.1.1 Raised Letters

a. Chemically weld 1/32 inch thick acrylic message letters to front surface of plaque as required by and ATBCB ADA TITLE III.

c. Mounting Location and Height: Locate along side of door on latch side, mounted between 54 and 66 inches above the bottom of the door. See ATBCB ADA TITLE III.

2.6.1.2 Engraving

Machine engrave message through face layer to expose contrasting second layer.

2.6.2 Plaque Messages

Sign characteristics and message content shall be as scheduled following "End of Section."

2.6.3 Mounting

2.6.3.1 Shim Plate

Provide aluminum shim plate with predrilled, size as required to shim sign level against irregular mounting surface countersunk holes to allow screw application to mounting surface. Provide mounting screws.

2.6.3.2 Mechanical Fasteners

Provide countersunk mounting holes in plaques and mounting screws.

PART 3 EXECUTION

3.1 EXAMINATION

Examine condition of locations and surfaces on which signs will be installed. Do not proceed with installation until defects or errors which would result in poor installation have been corrected.

3.2 INSTALLATION

Install signs at locations as indicated. Ensure that signs are installed plumb and true, at mounting heights indicated, and by method shown or specified. Do not install signs on doors or other surfaces until finishes on such surfaces have been applied.

3.2.1 Anchorage

Provide anchorage to ensure that signs are fastened securely in place. Anchorage not otherwise specified or indicated shall include slotted

inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Provide slotted inserts of types required to engage with anchors.

3.3 PROTECTION

Protect work and adjacent work and materials against damage during progress of work until completion. Wrap finished work with paper, polyethylene film, or strippable waterproof tape for shipment and storage and protect from damage during installation.

3.4 ADJUST AND CLEAN

Repair damage to signs incurred during installation. Replace signs which cannot be repaired to new condition. Clean glass, frames, and other sign surfaces; adjust hardware and electrical equipment for proper operation.

-- End of Section --

SIGN SCHEDULE														
Sign														
Mark ¹	Type ²	Format ³	Size		Color	Mounting			Lettering					Remarks
			Width	Height		Location	Method	Height to Top	Height	Style	Color	Message	Faces	
C-1	C	10402	20"	14"	Yellow	Hanging	Chain	5'-6"	1" min	Helvetica	Black	CAUTION Equipment Start Automatically	1	
D-1	C	10401	20 ²	14 ²	White	Door	Screws or Bolts	5'-6"	1 ² min.	Helvetica	Black	DANGER High Voltage	1	
D-4	C	10401	20 ²	14 ²	White	Wall	Bolts	5'-6"	1 ² min.	Helvetica	Black	DANGER No Smoking	1	
D-5	B	10401	20 ²	14 ²	White	Pipe Post	Bolts	3'-6"	1 ² min.	Helvetica	Black	DANGER No Smoking	1	
D-6	C	10401	20 ²	14 ²	White	Wall	Bolts	3'-6"	1 ² min.	Helvetica	Black	DANGER Nonpotable Water Not for Drinking	1	Provide at interior W2 hose valves
D-7	B	10401	20 ²	14 ²	White	Pipe Post	Bolts	3'-6"	1 ² min.	Helvetica	Black	DANGER Nonpotable Water Not for Drinking	1	Provide at exterior W2 hose valves
D-10	B	10401	14 ²	10 ²	White	Fence	Bolts	5'-6"	1 ² min.	Helvetica	Brown	DANGER HIGH VOLTAGE	1	
Interior Plaque		--	10"	4"	White	Wall	Screws	As specified	1 ² min.	Helvetica	Brown	Toilet	1	Graphic Application
Interior Plaque		--	10"	4"	White	Wall	Screws	As specified	1 ² min.	Helvetica	Brown	Office/ Electrical Room	1	Graphic Application

¹Numbers refer to a particular sign type with a particular message.
²Letters refer to sign types specified in this section.
³Numbers refer to Standard Details that show sign layout.

SECTION 10520

PORTABLE FIRE AND SAFETY EQUIPMENT
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.2 SUBMITTALS

Submit the follow in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Portable Fire Extinguishers G

1.2.2 SD-08, Statements

- a. Current UL listing or FM approvals G

PART 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS (F. EXT-1)

NFPA 10, provide UL listed extinguishers, charged, and ready for service. Provide portable extinguishers with the following:

- a. Tri-class dry chemical extinguishing agent.
- b. Pressurized, red enameled steel shell cylinder.
- c. Activated by top squeeze handle.
- d. Agent propelled through hose.
- e. For use on A, B, and C class fires.
- f. Minimum UL Rating 4A-60BC, 10-pound capacity.

2.2 ACCESSORIES

Provide necessary screws, bolts, brackets, and other fastenings, of suitable type and size to secure items in position.

2.2.1 Fasteners

Provide stainless steel fasteners. Provide metal expansion shields for machine screws at masonry.

2.2.2 Brackets

Provide heavy duty brackets with clip-together strap for wall mounting for all portable fire extinguishers.

PART 3 EXECUTION

3.1 INSTALLATION

Install where indicated or directed and in accordance with manufacturer's recommendations.

- a. Installation shall be plumb and level.
- b. Rigidly attach brackets to structure.
- c. Provide adequate backing for mounting surface.
- d. Set top of extinguisher no more than 5 feet above the floor.

-- End of Section --

SECTION 10800

TOILET AND BATH ACCESSORIES
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2380	Dispenser, Paper Towel
CID A-A-2524	Holder, Toilet Paper (Single Roll)

FEDERAL SPECIFICATIONS (FS)

FS DD-M-411	(Rev. C) Mirrors, Glass
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1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

a. Manufactured units

Submit for each type of accessory specified. Include descriptions of materials, finishes, fastening and anchoring devices, and appurtenances.

1.2.2 SD-13, Certificates

a. Manufactured units

Submit for each type of accessory specified, attesting that materials meet the specified requirements.

1.2.3 SD-14, Samples

a. Manufactured units

Submit one of each type of accessory complete with appurtenances and finished as specified. Approved samples may be installed in the work provided each sample is labeled for identification and location recorded.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in unopened containers, labeled with the manufacturer's names and brands, ready for installation. Store accessories in safe, dry locations until needed for installation.

PART 2 PRODUCTS

2.1 MATERIALS AND FABRICATION

Fabricate accessories in accordance with commercial practice, with welds ground smooth. Bend, flange, draw, form, and perform similar operations in a manner to ensure no defects. Flanges of recessed accessories to return to walls to provide a continuous, tight-against-the-wall installation. Doors shall be warp free. Key manufacturer's standard locks alike, for groups of accessories; two keys furnished for each group.

2.2 FINISHES

Finishes on metals not specified otherwise shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Corrosion-resisting Steel (Stainless Steel), Aluminum	General-purpose Polished Satin Anodic, Clear

2.3 MANUFACTURED UNITS

2.3.1 Toilet Tissue Dispensers (Surface Mounted) (TTD)

2.3.1.1 Type II, Roller Mounted on Single Continuous Bracket

CID A-A-2524, chromium plated steel. Holder shall consist of wall plate with one stationary or integral post and one hinged post. Fix a roller or bar to the stationary post. The holder shall be antipilfering type.

2.3.2 Paper Towel Dispenser (Surface Mounted) (PTD/R)

CID A-A-2380, stainless steel.

2.3.2.1 Combination Paper Towel Dispenser/Waste Receptacle Units (PTD/R)

A surface mounted type. Dispenser shall have a capacity of 400 sheets of any type paper towels. Waste receptacle shall be designed for locking in unit and removing for service. Waste receptacle shall have a capacity of 12 gallons. Units shall be fabricated from 22-gage stainless steel welded construction with all exposed surfaces to have satin finish. Provide waste receptacle with reusable liner of the type standard with the unit manufacturer.

2.3.3 Grab Bars (GB-1 and GB-2)

Surface mounted, stainless steel, 1 1/4 inches in diameter, with a nominal wall thickness of not less than 0.05 inch (18 gage), of shape indicated, and with a nonslip finish. Grab bars and mounting devices shall be capable of withstanding a static load of 250 pounds at any point on the bar.

2.3.3.1 Grab Bar Lengths

a. GB-1: 36 inches long.

b. GB-2: 52 inches long.

2.3.4 Liquid Soap Dispensers (LSD)

Lather dispersed by stainless steel spring action "push-in" valve, capacity of 10 fluid ounces.

2.3.5 Mirrors (MIR-S)

Class 2, Style E, Grade 1, electrocopper plated, conforming to FS DD-M-411, except that mirror shall be capable of being tilted forward or returned to upright position and mirror shall be equipped with an integral shelf for the full width of the mirror and a back of the type standard with the manufacturer. Size shall be 18 inches wide by 30 inches high. Shelf shall be the mirror manufacturer's standard type that forms the coved bottom member of the mirror frame as a single unit. Shelf shall be not less than 0.050 inch thick and 5 inches deep, with rounded ends; material and finish as specified for mirror frame.

2.3.6 Seat Cover Dispenser (SCD)

Stainless steel, polished finish. Seat cover only. Style surface mounted and shall have a capacity of 200 seat covers.

2.3.7 Facial Tissue Dispenser (FTD)

Surface mounted. Dispenser shall have capacity of 200 two-ply facial tissues.

PART 3 EXECUTION

3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction.

-- End of Section --

SECTION 11305

GROUNDWATER EXTRACTION WELL SUBMERSIBLE PUMP SYSTEMS
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install, complete, the submersible extraction well pumps and control system specified herein. The system includes, but is not limited to, thirty-four (34) submersible pumps and pump control instrumentation located in the extraction well vaults. In addition, Groundwater Extraction Well Submersible Pump Systems supplier shall be responsible for supplying the instrumentation and control components in the Electrical Vaults.

1.2 EQUIPMENT NUMBERS

- a. Extraction Well Submersible Pumps: P-1-1 through P-1-34.

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Extraction well submersible pumps G
- b. Submersible pump motors
- c. Well vault hatch G
- d. Well cap

1.3.1.1 Extraction Well Submersible Pumps

Catalog information including materials of construction, dimensions and clearances, and equipment accessories. Include performance data curves showing head in feet, capacity in gallons per minute, horsepower demand, and efficiency over the entire operating range. Indicate operating points on the pump curves.

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G

1.3.2.1 Layout Drawings

Detailed mechanical and electrical drawings showing well vault, hatch, and equipment fabrications and dimensions, extraction well vault piping layouts, coupling locations, and interfaces with other items.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.3 SD-06, Instructions

- a. Manufacturer's installation instructions G
- b. Spare parts and special tools

1.3.3.1 Manufacturer's Installation Instructions

Two (2) copies of the pump installation procedures shall be furnished to the Navy's Technical Representative (NTR) prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for the extraction pumps and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

- a. Design calculations G
- b. Manufacturer's Certificate of Proper Installation

1.3.4.1 Design Calculations

Design calculations for the well vault and sizing of the extraction well submersible pumps, signed and sealed by a registered engineer. Pump calculations shall include Total Dynamic Head calculations for the system.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a legal representative of the extraction well submersible pump manufacturing firm, stating the representative has visually observed the installation, and confirms the pumps are installed in accordance with manufacturer's written and recommended instructions.

1.3.5 SD-12, Field Test Reports

- a. Field Testing

1.3.6 SD-19, Operation and Maintenance Manuals

- a. Extraction well submersible pumps and accessories, data package 4.
G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

Insofar as is practical, the equipment specified herein shall be factory assembled. The manufacturer shall furnish all necessary instructions for receipt, unloading, and storage of equipment and materials furnished by the manufacturer. During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials which the manufacturer and NTR indicates is not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 MANUFACTURER'S SERVICES

- a. The manufacturer of the extraction well submersible pumps shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations, and is ready for permanent operation.
 3. Field testing support as specified hereinafter.

1.8 QUALITY ASSURANCE

The manufacturer shall guarantee all equipment as to workmanship, materials, and satisfactory functioning for 12 months from the date of its startup or 18 months from the date of shipment, whichever is longer. At

the manufacturer's total expense, promptly rectify any failure covered by this guarantee.

PART 2 PRODUCTS

2.1 GENERAL

Electrical materials and workmanship required to complete the work under this section shall conform to the applicable requirements of Section 16050, "Basic Electrical Materials and Methods."

- a. Coordinate pump and motor requirements with adjustable frequency drive (AFD) manufacturer and be responsible for pump and AFD requirements.
- b. Furnish a coordinate operating system complete with pump and AFD.

2.2 SERVICE CONDITIONS

- a. The extraction well submersible pumps shall be installed in existing wells 6 inches in diameter. The pumps are components of a groundwater remediation system which will extract chlorinated organic compounds from a contaminated groundwater aquifer, and shall be suitable for this service. Pumps shall be suitable for continuous duty and extended operation.
- b. Groundwater sampling indicates no extraordinary conditions of pH or mineral content.
- c. Service conditions for design:
 1. Liquid Pumped: Groundwater contaminated with a variety of chlorinated organic compounds. Trichloroethylene is the most prevalent compound with concentrations as high as 250 ppm. The Phase II Aquifer Testing Report (CH2M HILL, 1997) contains information on additional groundwater contaminants that may be present in the aquifer.
 2. Liquid Temperature (LT): 50 to 60 degrees F.
 3. Specific Gravity at LT: 1.0.
 4. Viscosity at LT: 1.0 centistokes
- d. Pump design requirements are provided at the end of this specification section.

2.3 PUMP CONSTRUCTION DETAILS

- a. Extraction pumps shall be commercially available with an integral electric motor and impeller stack. Each pump shall be suitably sized for the required discharge flow indicated at the end of this section, and the total dynamic head (TDH) requirements calculated by the contractor during final system sizing. Preliminary TDH requirements, provided at the end of this section, are based on information available during the preliminary design. Contractor shall be fully responsible for providing pumps meeting the TDH requirements the contractor calculates during the final design.

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

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- b. Materials: The pump bowls, impellers, shaft, coupling, and motor shell shall be a minimum of 300 series stainless steel.
- c. Motor: Motors shall be 460-volt, 3-phase. The motor shall be water filled for cooling and lubrication. Adjustable Frequency Drives shall be provided under Section 16402, "Interior Distribution System."
- d. Power Supply Cable: Provide each pump with the required length of heavy-duty waterproof power supply cable suitable for submerged service.

2.4 PUMP ACCESSORIES

- a. Pump Identification Plate: A 16-gauge stainless steel identification plate shall be mounted at each well head in a readily visible location. The plate shall bear the 1/4-inch die-stamped equipment identification number that is assigned each pump and listed hereinbefore. In addition, the plate shall list the pump manufacturer, make, model, capacity, horsepower, and voltage rating.
- b. Drop Cable: Provide 1/8-inch flexible stainless steel drop cable attached directly to the pump for raising and lowering the pump in the well. Provide stainless steel cable connector.
- c. Cable Clips: Provide nylon cable clips to secure power and drop cable to down pipe at a minimum of five-foot intervals.
- d. Pump Discharge Adapter: Provide an NPT stainless steel nipple or adapter in the discharge chamber of the pump for connection to galvanized steel discharge piping.
- e. Check Valve: Provide manufacturer's standard integral check valve as part of the pump body.
- f. Lightning Arrestor: Provide manufacturer's standard lightning arrestor, suitable for outdoor application and type of electrical service.
- g. Torque Arrestor and Torque Stops: Provide manufacturer's standard torque arrestor to absorb thrust of motor startups and to keep pump centered in well. Provide torque stops, installed at intervals recommended by pump manufacturer, to keep wire from rubbing against side of well.

2.5 SPARE PARTS AND SPECIAL TOOLS

- a. Provide one complete set of special tools, as recommended by the manufacturer, required for operation, maintenance, and complete disassembly of each pump model installed.
- b. Provide four (4) complete sets of manufacturer recommended spare parts for each different pump model installed.
- c. Provide one (1) complete spare pump with integral motor assembly for each different pump model installed.

2.6 WELL VAULT INSTRUMENTATION

2.6.1 General

The extraction well submersible pumps are part of a groundwater extraction and control system. The system includes level, pressure, and flow instruments, controls, and fittings in the well vaults necessary to provide precise control of the well water level and groundwater extraction rate. This section describes the instruments and controls which the contractor shall provide to produce a functioning groundwater extraction and control system. Specific requirements for each component are also listed in Section 13000, "Instrumentation Components," and Section 15100, "Valves and Operators."

2.6.2 Air Release Valve

Provide an air release valve on each well head in accordance with Section 15100, "Valves and Operators." Valve shall be suitable for water service, and shall automatically exhaust small amounts of entrained air that accumulates in the system, in CLOSED position, seat against resilient seat to prevent water leakage. Valve shall be rated 150 psig working pressure, cast iron, ductile iron, or semi-steel body, cover with stainless steel float and trim.

2.6.3 Isolation Ball Valves

Provide ball valves in accordance with Section 15100, "Valves and Operators."

2.6.4 Flow Meter

Provide a turbine flow meter as specified in Section 13000, "Instrumentation Components."

2.6.5 Globe Valve

Provide a globe valve in accordance with the requirements of Section 15100, "Valves and Operators."

2.6.6 Swing Check Valve

Provide a swing-type check valve in accordance with Section 15100, "Valves and Operators."

2.6.7 Sample Port

Provide valved sample port consisting of a ball valve in accordance with Section 15100, "Valves and Operators."

2.7 WELL VAULT HATCH

Provide 4-foot by 4-foot double-leaf aluminum access hatch. Provide zinc-plated and chromate sealed hardware.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

Install all equipment in accordance with manufacturers' recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.

3.2 FUNCTIONAL TESTS

Each extraction well submersible pump and associated controls shall be field tested under normal or simulated operating conditions in the presence of the NTR for one (1) hour. Each pump shall be operated at its design flow rate or other such point on its head-capacity curve as selected by the NTR. The contractor shall provide an accurate and acceptable method of measuring discharge flow and pressure. Contractor shall record discharge pressure and capacity with all valves completely open after 30 minutes of testing, and shall record discharge pressure at design capacity at the completion of the one hour test. Tests shall also demonstrate that the pumps and associated controls and appurtenances have been installed correctly, that there is no objectionable vibration or noise from any parts, and all manual and automatic controls function properly to the satisfaction of the NTR.

3.3 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. Two (2) person-days for assistance during installation of the extraction pumps and associated controls.
- b. Two (2) person-days for participation and support during the FUNCTIONAL TESTS, calibration and adjustment of pumping systems, and for completion of Manufacturer's Certificate of Proper Installation.
- c. One (1) person-day for pre-startup or post-startup site training of plant operations personnel.

3.4 PUMP DESIGN REQUIREMENTS

The groundwater extraction pump design requirements are listed in the following table. Contractor shall use the ground surface elevations, water table elevations, expected drawdowns, pump inlet elevations, and pump operating capacity to size each pump. Contractor shall note that TDH and horsepower requirements indicated in the table are based on information available during the preliminary design. Contractor is fully responsible for calculating final TDH and horsepower requirements, and providing pumps to meet the final requirements.

-- End of Section --

SECTION 11310

MULTIMEDIA PRESSURE FILTRATION SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install, complete, a factory assembled, vertical pressure-type multimedia filtration system shipped with control panel, manifold piping, appurtenances, and accessories, for simple connection to treatment system process piping. All equipment and materials shall be supplied per the specifications as intended for a complete and operational system. The filter system is intended for removal of hydroxide precipitants and suspended solids down to 10 microns in size and larger.

1.2 EQUIPMENT NUMBERS

Pressure Filters: F-3-1-1, F-3-1-2.

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Pressure filtration system G

1.3.1.1 Pressure Filtration System

Provide catalog information including vessel specification, dimensions, and design pressure, design flow rate and backwash rate, pressure drop at design flow rate and backwash rate, and recommended backwash duration. Provide manufacturer's specification of filter media to be used, including specific gravity of each media type, and effective size and uniformity coefficient of each of the fine media. Include grain size ranges for each media. Gravel sizes shall be in inches or U.S. sieve sizes. Fine media sizes shall be in millimeters. Provide manufacturer's specification of the filter system control panel to be supplied, including functionality, and operator interfaces.

1.3.2 SD-04, Drawings

a. Layout drawings G

b. Wiring diagrams G

c. Instrumentation details G

1.3.2.1 Layout Drawings

Detailed mechanical drawings showing equipment fabrications, dimensions and weights, materials of construction, piping layouts, connection sizes, types, and locations, nozzle orientations and details, and interfaces with

other items. Show all valving and instrumentation components. Provide a flow diagram of system valving operations.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams for the local control panel.

1.3.2.3 Instrumentation Details

Instrumentation details including pneumatic valves, differential pressure gauges, and local control panel.

1.3.3 SD-06, Instructions

a. Manufacturer's instructions G

b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the pressure filter system installation procedures shall be furnished to the Navy's Technical Representative (NTR) prior to installation. Instructions shall include erection and installation details, including fastening details. Instructions shall also cover field installation of the filter media. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts

List of recommended spare parts for the pressure filter system, required to keep the equipment in service for a period of one (1) year, along with current price information.

1.3.4 SD-08, Statements

a. Manufacturer's Certificate of Proper Installation

1.3.4.1 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a factory authorized service representative of the filter system manufacturing firm, stating the representative has visually observed the installation, and confirms the system is installed in accordance with manufacturer's written and recommended instructions.

1.3.5 SD-11, Factory Test Reports

a. Factory test reports for pressure filter system

1.3.6 SD-12, Field Test Reports

a. Field Testing

1.3.7 SD-19, Operation and Maintenance Manuals

a. Provide O&M manuals for the system. Include detailed information on backwashing procedures, tailored to this application, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage, to the satisfaction of the NTR, to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 NAMEPLATES

Each filter vessel shall have a nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, catalog number, and pressure rating. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.8 MANUFACTURER'S SERVICES

- a. The manufacturer of the pressure filter system shall provide a factory authorized service representative for technical assistance during installation, startup, and training. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. On-site installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations and written instructions; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the

manufacturer's recommendations and written instructions, and is ready for permanent operation.

3. On-site training of plant operations personnel in operation, troubleshooting, and backwashing procedures for the system.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

Material to be treated by the pressure filters will consist primarily of iron and manganese hydroxide precipitants from the iron and manganese oxidation process, and suspended solids. Working temperatures will range from 45 to 65 degrees F, and pH will range from 6 to 8. Working pressures will range from 20 to 70 psig. Total suspended solids concentration is expected to be around 10 mg/l.

2.2 EFFLUENT WATER QUALITY

Filter effluent shall be free of particulate matter larger than 10 microns in size.

2.3 OPERATIONAL PARAMETERS

The system shall include two pressure filter vessels operating in parallel during normal operating conditions. Each vessel shall be sized for a surface loading of 4 gpm/sf. During backwashing operations, one vessel shall be backwashed at a time, and the entire influent flow shall be diverted through the operating vessel, maintaining a surface loading of 8 gpm/sf in the operating vessel during backwashing.

2.4 DESIGN PARAMETERS

System Operation:	Parallel
System Design Flow:	220 gpm
Design Flow per Vessel:	110 gpm
Pressure Loss of Clean Filter at Design Flow:	5 psig (each vessel)
Max. Pressure Loss of Dirty Filter Prior to Backwash:	20 psig (each unit)
Surface Loading:	4 gpm/sf
Backwash Flow:	420 gpm per vessel
Backwash Water Source:	Elevated Water Storage Tank (T-8-1)
Control Panel Electrical Requirement:	120 VAC/60 Hz/single phase
Vessel Diameter (each unit):	6 feet
Freeboard:	50% minimum

2.5 EQUIPMENT SCHEDULE

- a. Filter Vessels: 2; Dia. 72 in.
- b. Manifold Pipe Size: 4 in.
- c. Pneumatic Block Valves: 4 in.

2.6 FILTER VESSELS

2.6.1 Fabrication

- a. Vessels shall be shop fabricated, complete, in strict accordance with the applicable requirements of the ASME Boiler and Pressure Vessel code, Section VIII, Division I, Unfired Pressure Vessels, and the latest addenda thereto. The work shall be performed in a shop which is regularly engaged in the manufacture of vessels in accordance with the requirements of this code.
- b. The tanks shall be completely shop fabricated and tested so that they can be installed in the field by the completion of bolted joints. No welding of the tanks will be permitted in the field.

2.6.2 Filter Vessels

- a. Vessels shall be constructed of carbon steel conforming to ASTM A 285 Grade C, as a minimum. They shall be designed, fabricated, erected, inspected, tested, stamped, and certified in accordance with the provisions of the ASME Boiler and Pressure Vessel Code, Section VIII, Division I, Unfired Pressure Vessels, and the latest addenda thereto. The tanks shall be rated for a cold water working pressure of 100 psig. The tanks shall be fitted with lifting lugs for handling and placement. The tanks shall be fusion-welded throughout.
- b. Two 24-inch manholes shall be installed in each vessel. One near the bottom of the vessel on the straight side shell, and the other on the elliptical top of the vessel. The quick opening manholes shall be ASME code, hinged, cam locked type, rated at 135 psig, minimum. The manholes shall be installed during tank fabrication and placed on the vessel prior to testing. The manholes shall have a neoprene gasket and a WCB-216 cast steel lid.
- c. Vessels shall have spooled flange connections on the service inlet and outlet extending six (6) inches on the inside and outside of the vessel.
- d. Supports for vessels shall be adjustable jack legs mounted on a skid.

2.6.3 Internal Distribution

- a. The upper distribution system shall be of the baffle type to evenly distribute the water over the entire tank area.
- b. The lower distribution system shall be constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the bed. Slotted lateral arms are unacceptable. The distribution system shall be embedded in a single layer subfill of washed 1/8" x 1/16" gravel to support the filter media.

2.6.4 Operating Valves

- a. All block valves shall be pneumatically actuated.
- b. The valve configuration shall be such that, under normal operating conditions, influent flow to the filter system is evenly split and distributed to both filter vessels. Upon operator-initiated backwash, all flow shall be diverted to one filter while the other

filter is backwashed. The operator shall be able to select either filter for backwashing.

2.6.5 Backwash Flow Controller

An automatic flow controller shall be provided to maintain proper backwash flow rates over wide variations in operating pressures and require no field adjustment. The flow controller shall be set at the factory with the proper backwash flow rate for this intended service.

2.6.6 Pipe and Fittings

Filter system manufacturer shall provide exterior piping connections between filter vessels so that field installation will consist primarily of connecting the filter system to the influent, effluent, and backwash piping. Piping shall be schedule 40 galvanized steel. Flanged fittings shall be cast iron standard class 125.

2.6.7 Exterior Painting

Vessels shall be factory primed and painted. The exterior of the vessels and exposed piping surfaces outside the vessels shall be painted. Surface preparation shall be accomplished using abrasive blast or centrifugal wheel blast. Apply one (1) coat, 2-3 mils minimum dry film thickness (MDFT) rust-inhibitive primer, and two (2) coats, 4 mils MDFT alkyd enamel.

2.6.8 Interior Coatings

The interior of the vessels and interior and exterior of all steel pipe inside the vessels shall be painted. Surface prepare interior surfaces by sandblasting to white metal (SSPC-SP5) with a 1 to 1-1/2 mil anchor pattern, then coat with 8-10 mils MDFT epoxy polyamide, potable grade meeting the requirements of the U.S. Federal Register, Food and Drug Regulations Title 21, Chapter 1, Paragraph 175.300.

2.7 FILTER MEDIA

The filter media shall be multi-layered and shall consist of three (3) distinct filter layers in addition to a support layer. Each layer shall be of a selected density and particle size to stratify in the same order following a backwash. The filter layers shall stratify with the coarsest layer at the top and finest layer at the bottom. Particle retention shall be 10 microns and larger.

2.8 FUNCTIONAL DESCRIPTION

- a. The following functional descriptions describing the operations of the filter system will be considered the essence of the specifications. Furnish and install all necessary equipment, instruments, software modules and appurtenances to achieve the performance as hereinafter described, even though such items may not be included in any specific listing of equipment furnished. An involved system of this nature requires emphasis on the functional aspects of the Specifications while the technical details serve to indicate the desired manner in which the end result will be accomplished.
- b. The electrical control system shall consist of a Local Control Panel (LCP-3) and external input devices to operate the filter

system semi-automatically and protect equipment and the treatment process from fault conditions. The control panel shall be a NEMA 4 enclosure containing power and control devices suitable for operating the filter system in accordance with the Drawings. Fabrication shall be performed by a UL approved shop experienced in the fabrication of industrial control panels.

c. Functional Requirements:

1. Under normal operation, both filters shall operate in parallel, and influent flow shall be evenly divided between the two filters.
2. Filter differential pressure shall be continuously monitored by differential pressure indicating transmitters, one located on each filter. Filter differential pressure signal shall be transmitted to the local control panel (LCP-3).
3. On high differential pressure in either filter, the local control panel shall activate an alarm indicator light on the panel, and a HIGH DIFFERENTIAL PRESSURE signal shall be transmitted to the Area Control Panel ACP-1, notifying the operator.
4. The operator will initiate backwash of the filter with high differential pressure by pushbutton on the local control panel. The local control panel shall automatically control all backwashing steps and return the filter system to normal operation following backwash.
5. The local control panel shall have a clear digital display. The control panel shall indicate backwashing status, indicating each step of the backwash cycle.

6. Upon operator initiated backwash, the local control panel shall automatically control the following backwash steps:

Flow transfer: The local control panel shall isolate the filter to be backwashed, and transfer the full influent flow to the operating filter.

Filter draindown: The contents of the filter shall be automatically drained from the vessel to the building floor drain. Drain down piping shall be hard-piped directly into the floor drain.

Backwashing: Following draindown, the local control panel shall initiate normal backwashing. The backwash duration shall be capable of being adjusted at the local control panel.

Return to service: Following backwashing, the local control panel shall automatically return the backwashed filter to normal service.

The local control panel shall automatically initiate any other backwash steps recommended by the manufacturer. These may include a settling time following upflow backwash where water is allowed to set in the filter for a preset time, or a downflow backwash cycle following upflow backwash.

The local control panel shall be configured such that the operator can select either filter for backwashing.

- d. External Interfaces: Furnish the following signals between the local control panel and the Area Control Panel ACP-1:

1. LCP-3 will receive a SYSTEM SHUTDOWN signal (normally open dry contact, close on signal) from the Area Control Panel ACP-1.

2. LCP-3 will send the following signals to the Area Control Panel ACP-1:

COMMON TROUBLE ALARM (normally open dry contact, close on alarm condition). Alarm signal will be sent upon backwash valve fail to actuate.

Filter STATUS-OUT OF SERVICE (each filter) (normally open dry contact, close on Filter STATUS-OUT OF SERVICE)

Filter STATUS-IN SERVICE (each filter) (normally open dry contact, close on Filter STATUS-IN SERVICE)

Filter STATUS-BACKWASHING (each filter) (normally open dry contact, close on filter backwash)

Filter HIGH DIFFERENTIAL PRESSURE (each filter) (normally open dry contact, close on HIGH DIFFERENTIAL PRESSURE)

3. LCP-3 shall receive a backwash permissive (normally open dry contact, closes on permissive) and start automatic backwash only when permissive is present.

- e. Operator Interfaces: Furnish operator interfaces on the control panel. The interfaces can either be indicating lights or actual words on the digital display, as appropriate. The following interfaces shall be provided:

1. Filter DIFFERENTIAL PRESSURE reading (each filter).

2. Filter HIGH DIFFERENTIAL PRESSURE visual alarm (each filter).

3. Filter STATUS-OUT OF SERVICE (each filter)

4. Filter STATUS-IN SERVICE (each filter)

5. Filter STATUS-BACKWASHING (each filter)

6. Color-coded key pad to allow operator to control time intervals, step through the backwashing sequence, and end the backwashing cycle prematurely.

2.9 ACCESSORIES

- a. Provide pressure gauges with diaphragm seals on inlet and outlet of each vessel. Gauges shall be in accordance with Section 13000, "Instrumentation Components." Gauges shall have a pressure range of 0-100 psig.
- b. Provide a differential pressure indicating transmitter for each vessel to determine when a backwash cycle must be initiated for that vessel.

- c. Provide sampling cocks on inlet and outlet of each vessel.
- d. Provide pressure relief valve on each vessel, sized and set by manufacturer for this intended service, and in accordance with Section 13000, "Instrumentation Components." Pressure relief valve discharges shall be piped to the building floor trench as shown on the Drawings.
- e. Provide a drain port off the bottom of each vessel.
- f. Air Set: For air supply to the system, provide a pressure regulator, solenoid valve, needle valve for control of pressurized air to the system.
- g. Provide an air release valve for each pressure vessel in accordance with Section 15100, "Valves and Operators."

2.10 CONTROL PANEL, LCP-3

Control panel shall be provided as described under Section 13390, "Package Control Systems." Voltage; 120 VAC, single phase. Main FLA; 15 amps.

2.11 FACTORY TESTING

Each vessel shall be hydrostatically tested in the fabrication shop after completion of all construction welding and fabrication. The hydrostatic test pressure shall be 150 psig (1-1/2 times the design pressure). Test pressure shall be maintained for a minimum of three (3) hours. Test failure shall be cause for rejection of the vessel. Provide manufacturer certified, written test results of satisfactory tests to the NTR upon filter system delivery to the jobsite.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Requirements

- a. Install all equipment in accordance with manufacturers' recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.
- b. Contractor shall furnish and install, at the locations shown on the Drawings, a packaged system including field instrumentation, control panel, filter vessels and media, wiring, piping, fittings, valves, anchor bolts and fasteners, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.

3.1.2 Filter Media Installation

- a. Media shall be transported and placed carefully to prevent contamination of any sort, and media made dirty before or after placement shall be replaced with clean media at the NTR's discretion.
- b. Each filter vessel shall be thoroughly cleaned to the NTR's satisfaction before any media is placed in the vessel.

- c. The bottom layer shall be placed carefully by hand to avoid movement of the underdrain system and to assure free passage of water from the orifices.
- d. Each media layer shall be installed complete before the next layer is started above. For materials less than 1/2-inch in diameter, the workmen shall not stand or walk directly on the gravel, but shall walk on boards that will sustain the weight of the workmen without displacing the media.
- e. The correct thickness of each layer shall be obtained as follows: Before any media is placed, the top of each layer shall be marked on the side of the vessel without damaging the vessel coating. The top of each layer shall then be leveled against a water surface held at the appropriate mark. None of the particles shall be less than half-submerged, and there shall be no places where additional media can be placed without the particles extending more than one-half their volume above the water surface.

3.2 FIELD TESTS

Prior to plant startup, all equipment shall be inspected for proper alignment, proper connection, and satisfactory performance, and any adjustments shall be made to the satisfaction of the NTR.

3.3 CONTROL SYSTEM ACCEPTANCE TESTS

- a. Field test the control system in order to meet the scheduling requirements. Conduct functional acceptance tests (FAT). The objective of these tests are to demonstrate that the control system is operating and complying with the specified performance requirements.
- b. Perform witnessed FATs on the complete control system. Demonstrate each function to the satisfaction of the NTR on a paragraph-by-paragraph basis.
- c. Each test shall be witnessed and signed off by both the NTR and the ROIC.
- d. For each test description include the following minimum information:
 - 1. Specification page and paragraph demonstrated.
 - 2. Description of function and test to demonstrate it.
 - 3. Space for sign off and date by the NTR and ROIC.

3.4 CONTROL SYSTEM RESPONSIBILITY

- a. All components of the control system have been included in this Section so that the contractor will receive a completely coordinated and properly integrated system for efficiency, ease in operation and correct functional relationship among all elements of the system. Therefore, it is the intent of this Specification that the equipment specified under this Section will be furnished by the filter system manufacturer. This requires that the filter

system manufacturer be responsible for the satisfactory operation of the instrumentation and control system furnished hereunder.

- b. The filter system manufacturer shall provide the following minimum materials and services:
 - 1. Design, assemble, furnish, and supervise installation of the control system.
 - 2. Check final power and signal connections.
 - 3. Adjust, tune, and calibrate system.
 - 4. Examine and, if required, coordinate modification of existing signals, wiring, or connections from the Area Control Panel ACP-1 for compatibility into the control system.
 - 5. Verify complete compatibility of existing wiring, signals, connections, with control system.
 - 6. Provide the advice, diagnosis and/or repair of control system during the warranty period.
- c. Provide all materials and services listed immediately above at no additional cost.

3.5 MANUFACTURER'S SERVICES

- a. Provide manufacturer's services for the minimum person-days listed below, travel time excluded.
 - 1. One (1) person-day for a manufacturer's/supplier's representative of the media specified herein to be present at the jobsite during the period the filter media and support media are being installed to supervise installation and to provide certification the materials were installed in each vessel in accordance with this Specification and his recommendations.
 - 2. One (1) person-day for filter system installation assistance, programming and setup of the local control panel, and completion of Manufacturer's Certificate of Proper Installation.
 - 3. One (1) person-day for pre-startup or post-startup site training of plant operations personnel. Training shall include backwashing initiation and completion. Training shall not commence until an accepted detailed lesson plan for each training activity has been approved by the NTR.

-- End of Section --

SECTION 11311

FIBERGLASS PACKAGED FLOW METERING STATION
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install, complete the fiberglass packaged flow metering station specified herein.

1.2 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Fiberglass packaged flow metering manhole
- b. Ultrasonic level flow metering equipment

1.2.2 SD-04, Drawings

- a. Metering Station Shop drawings G

1.2.2.1 Metering Station Shop Drawings

Shop drawings shall include descriptive information as required to fully describe the fiberglass package flow metering station, level sensors, controls, and overall performance. The drawings shall identify any deviations from the specified requirements.

1.2.3 SD-06, Instructions

- a. Manufacturer's installation instructions G
- b. Spare parts and special tools

1.2.3.1 Manufacturer's Installation Instructions

Two (2) copies of the pump installation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.2.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for the air stripper, blower, effluent pumps, and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.2.4 SD-19, Operation and Maintenance Manuals

- a. Ultrasonic level flow metering equipment G

1.3 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the job site. Equipment of the same types shall be the product of one manufacturer.

1.4 DELIVERY

Insofar as is practical, the equipment specified herein shall be factory assembled. The manufacturer shall furnish all necessary instructions for receipt, unloading, and storage of equipment and materials furnished by the manufacturer. During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.5 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials which the manufacturer and NTR indicate are not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.6 MANUFACTURER'S SERVICES

- a. The manufacturer of the metering manhole and flow metering equipment shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 - 1. On-site installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 - 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations, and is ready for permanent operation.

3. Field testing support as specified hereinafter.

1.7 QUALITY ASSURANCE

The manufacturer shall guarantee all equipment as to workmanship, materials, and satisfactory functioning for 12 months from the date of its startup or 18 months from the date of shipment, whichever is longer. At the manufacturer's total expense, promptly rectify any failure covered by this guarantee.

PART 2 PRODUCTS

2.1 FIBERGLASS METERING MANHOLE

2.1.1 General Requirements

- a. The fiberglass packaged flow metering station shall be a completely integral unit consisting of a 48-inch corrosion resistant fiberglass reinforced plastic (FRP) station with sealed fiberglass bottom, 30-inch concentric manway opening, aluminum access ladder, metering flume, utility tap, and internal instrument racks. The metering station shall be designed and manufactured in accordance with ANSI/ASTM D3753-79 Standard Specification. The fiberglass station shall be fabricated in one integral piece that is structurally strong, lightweight, watertight, and resistant to groundwater.
- b. The flume shall be a 1.0 foot H flume type with end couplings designed to mate with a 6-inch ID PVC incoming plant effluent pipe and an outgoing 12-inch ID PVC plant effluent pipe. Two neoprene boots with stainless steel clamps sized to connect the inlet and outlet pipe to the flume adapter shall be supplied by the manufacturer. The station will be equipped with hold down brackets for anchoring the unit to a concrete base slab. A 1/2-inch thick expanded polystyrene bead board will be supplied for placement on the concrete slab under the station.

2.1.2 Connection Sleeves

The FRP station and flume shall be provided with collars for connection to the incoming and outgoing pipes. The flume adapters shall allow a smooth flow transition from pipe flow to flume flow.

2.1.3 Height Requirements

The fiberglass station will be approximately 6.0 feet from the outlet pipe invert to the top cover. The Contractor shall verify actual dimensions based upon final design of vertical profile of the outfall pipe.

2.1.4 Flume

- a. The trapezoidal flume shall be designed to handle a normal flow of 75 gpm. The expected peak flow is 250 gpm and the low flow is expected to be 0 gpm. The flume shall be an H type flow measurement flume. The flume inside surface shall be smooth, white isophthalic gelcoat of 10 to 20 mil thickness. The flume shall be constructed of orthophthalic polyester resin reinforced with fiberglass. The minimum glass content shall be 30 percent

exclusive of gelcoat surfaces. Nominal wall thickness shall be a minimum 1/4-inch.

- b. The flume shall be furnished with an ultrasonic mounting bracket to accept a flow level meter as specified.
- c. The flume shall be bonded to the station to form a totally integral flow measurement package. The resultant structure shall be watertight.

2.1.5 Access Ladder

The package flow metering station shall be furnished with an internal aluminum ladder to provide easy access.

2.2 FLOW METER

2.2.1 General Requirements

The flow meter shall be capable of continuously recording and totalizing open channel flow level through the flume, and converting level to flow rate in gallon per minute units. The level sensor shall be powered by 120-volt AC power.

2.2.2 Level Sensor

- a. An ultrasonic level sensor shall be utilized to measure liquid level in the flume. The sensor shall consist of a single Teflon covered ultrasonic transducer, housed in a corrosion resistant acetyl plastic enclosure. The sensor shall be mounted within 1-foot of the maximum liquid level in the flume. The measurement span shall be from 1 to 10 feet with an accuracy within 1-percent of full scale. The sensor shall include a Teflon-covered stainless steel temperature probe to measure air temperature at the probe and compensate for air temperature changes. Air temperature changes shall be automatically compensated to within 1 percent of full-scale range in stable, constant air ranging from -13 degrees F to 140 degrees F. The sensor shall be supplied with a 50 foot 4 conductor connect cable for connection to the flow meter. All cables shall be 0.3-inch diameter, and shall include a polyvinyl chloride (PVC) jacket. A stainless steel mounting bracket shall be provided for rigid mounting of the sensor.
- b. Measure liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversion information for use with the type of flume used in the station. The flow meter shall also be capable of accepting up to four sets of 50 manually-entered level-flow rate data points. The flow meter shall then calculate a least squares fit equation for the entered data points.

2.2.3 Data Storage and Output

- a. Programming the flow meter shall be accomplished using a built-in tactile keypad and alphanumeric liquid crystal display (LCD). The LCD shall prompt the user through the programming sequence. As values are entered on the keypad, they shall be simultaneously displayed on the LCD.

- b. Level, flow rate, and totalized flow shall be displayed and recorded in units selected by the user. The flow meter shall be capable of measuring level in inches and feet. Flow rate information shall be indicated in gallons per minute. Totalized flow shall be in gallons. The total flow shall be directly displayed in engineering units; no conversions, exponents, or multiplying factors shall be required.
- c. The internal data storage memory shall have a capacity of up to 10,000 level readings or events divided in up to three user defined memory partitions. Timing for the data storage shall be selectable in 1,2,5,10,15,30,60, or 120-minute intervals.
- d. The flow meter shall be housed in a rugged, watertight, dust-tight, corrosion resistant (self-certified; NEMA 4X), 1/4-inch thick, high-impact strength, structural foam enclosure. The enclosure shall include an integral wall mounting bracket, and a large polycarbonate viewing window to allow the total flow, chart record, and LCD readings to be viewed without opening the enclosure. All exterior parts shall be stainless steel. An internal, easily replaceable, rechargeable desiccant dryer canister shall keep the interior of the flow meter moisture free.
- e. A built-in digital plotting device shall record the flow rate and totalized flow as measured by the flow meter. An impact dot matrix ribbon printing mechanism shall be used to produce this record. Flow rate, total flow, time of day, date, site identification, flow conversion and full scale span shall be recorded simultaneously on a 4-1/2-inch wide plain paper tape. The plotter shall automatically print a graduated chart background for the chart record. An automatic over-range feature shall extend the flow rate span by a factor of two in the event of an over range condition. The plotter shall have selectable chart speeds of 0.5 to 4 inches per hour. An automatic chart reroll mechanism shall allow long-term, unattended collection of data, for a period of up to 65 days. The chart paper supply and reroll shall be readily accessible for facilitate chart paper changing. Supply twelve extra roll of chart paper with the flow meter.
- f. Internal programming shall allow the plotter to generate flow summary reports on command, or selected time intervals. The flow summary report shall contain the site number, report interval, maximum and minimum flow rate, and the time of the occurrence, average flow rate, interval flow volume, and totalized flow volume. Flow meter set-up parameters shall be printed directly on the chart paper on command.
- g. The meter shall be provided with a 4 to 20 milli-amp analog interface signal proportional to the flow. The interface shall operate on 120-volt AC power. The interface shall be packaged in a self-certified, NEMA 4X enclosure. The interface shall be mountable on the flow meter.
- h. Provide operations and maintenance manuals for the station including the flume and metering equipment.

PART 3 EXECUTION

3.1 INSTALLATION

The fiberglass packaged flow metering station shall be installed in accordance with the specifications and in a manner consistent with the installation instructions and recommendations of the manufacturer. The Contractor shall ensure that good construction and installation procedures are followed throughout handling, storage, and placement to ensure the station is not damaged in any manner, and that maximum serviceable results are achieved.

3.2 HANDLING AND STORAGE

During loading, unloading, and storage, care shall be exercised to ensure that the station is not dropped or otherwise damaged through impacting with solid surfaces. The station shall be stored on a smooth surface, free of sharp objects, and if laid horizontally, shall be placed in such a manner as to avoid structural damage to the inlet and outlet channels. Slinging will be accomplished using nylon or other fabric material. Under no circumstances will cable or chain slings be used.

3.3 SITE PREPARATION

The site shall be excavated wide enough to accommodate the station and to provide a safe working environment for workers. The Contractor shall provide a level concrete slab 8 inches thick and smooth troweled surface, and level to 1/8 inch. The pad elevation shall be proportioned so that the invert of the station piping matches that of the pipeline.

3.4 PLACEMENT AND FINAL INSTALLATION

Prior to placement, the slab shall be cleaned of all sharp objects and debris, and the foam pad, supplied with the unit, properly placed on the slab. Neoprene boots supplied with the unit shall also be placed onto the flume adapters before lowering the station onto the concrete slab. The flow metering station shall be lowered onto the slab and properly located on anchor bolts in accordance with manufacturer's written instructions and recommendations. Slip neoprene boots with stainless steel clamps over pipe ends and tighten clamps securely. Under no circumstances shall lubricants of any type be used to install boots. Anchor bolts shall be securely tightened to tie downs on the station and the flume level checked as necessary.

3.5 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for assistance during installation of the flow meter and associated controls and support during the calibration and adjustment of metering equipment.
- b. One (1) person-day for training of plant operations personnel.

-- End of Section --

SECTION 11312

PACKAGE LIFT STATIONS
12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Fixed Ladders

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1994) Carbon Structural Steel

ASTM A 153 (1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 283/A 283M (1993; Rev. A) Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM C 443 (1994) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

ASTM C 478 (1994) Precast Reinforced Concrete Manhole Sections

ASTM C 913 (1989) Precast Concrete Water and Wastewater Structures

ASTM D 4101 (1994) Propylene Plastic Injection and Extrusion Materials

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110/A21.10 (1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids

AWWA C111/A21.11 (1990; Erratum 1991) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C115/A21.15 (1988) Flanged Ductile-Iron Pipe with Threaded Flanges

ANSI/AWWA C151/A21.51 (1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C508 (1993) Swing-Check Valves for Waterworks

Service, 2 in. (50 mm) Through 24 in. (600 mm) NPS

HYDRAULIC INSTITUTE (HI)

HI SCRRP (1983) Centrifugal, Rotary & Reciprocating Pumps

MILITARY SPECIFICATIONS (MIL)

MIL-C-18480 (Rev. B) Coating Compound, Bituminous, Solvent, Coal-Tar Base

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-78 (1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ICS 2 (1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NEMA MG 1 (1993; Rev. 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1993) National Electrical Code

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 LIFT STATION CRITERIA

1.3.1 Packaged Lift Station

Provide a complete, factory-built, automatic, underground pumping station with equipment factory installed in a precast concrete chamber with entrance tube and ladder. Principal items of equipment shall include two submersible, electric motor driven, non-clog sewage pump, valves, internal piping, central control panel with circuit breakers or fused disconnects, motor starters and automatic controller, alternators, alarms, ventilator, and internal wiring.

1.3.2 Performance Requirements

Provide two pumps, each pump shall be capable of delivering 45 gallons per minute of raw, unscreened sewage against a total dynamic head (TDH) of 19.5 feet, with a maximum allowable pump speed of 1750 rpm, and a minimum rated horsepower of each pump motor of 0.5.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Packaged lift station

1.4.1.1 Data Contents

Submit pump performance data and curve, and literature describing the following:

a. Pumps

b. Motors

c. Equipment chamber

d. Control panel

e. Level control

1.4.2 SD-04, Drawings

a. Packaged lift station

b. Equipment foundations

Include outline dimensions, support details, cross section, and control wire diagram.

1.4.3 SD-08, Statements

a. Foundation approval certificate

When required by the Contracting Officer, obtain from equipment manufacturer approval of foundation design and construction for equipment involved.

1.4.4 SD-18, Records

a. Posted operating instructions

1.4.5 SD-19, Operation and Maintenance Manuals

a. Packaged lift station

Submit operation and maintenance Data Package 3 in accordance with Section 01781, "Operation and Maintenance Data."

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Shipping

Ship station as one unit, unless size of plant prohibits such delivery. Where undeliverable as a single unit, ship in separate pieces designed for

easy assembly in field and for sound structural strength of final assembly. Package other equipment and parts for shipment to prevent breakage, damage, or cause out-of-adjustment calibration readings of controls.

1.5.2 Handling

Handle station at site with machinery adequate to move safely and without damage to personnel or station. Use station lifting eyes and lugs provided for purpose of lifting station. Inspect lift station and other materials to assess damage.

1.5.3 Storage

Protect from the weather and accidental damage. Store and handle cables carefully to avoid damage to outer covering or insulation and damage from moisture and weather. Protect electrical and mechanical equipment and accessories until installed and accepted. Structural materials, plain or fabricated, may be stored outdoors aboveground on platforms, skids or other supports. Keep materials free from dirt, grease, and other foreign matter during storage, and protect from corrosion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel

2.1.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.1.2 Plate

ASTM A 283/A 283M, Grade C, bent or cold formed.

2.1.2 Sewage Piping and Fittings

2.1.2.1 Ductile-Iron Pipe

ANSI/AWWA C151/A21.51, thickness Class 50.

2.1.2.2 Flanged Pipe

AWWA C115/A21.15.

2.1.2.3 Fittings

AWWA C110/A21.10, flanged or mechanical joint. Provide flanged joint fittings within equipment enclosure and abovegrade. Provide mechanical joint fittings outside equipment enclosure underground.

2.1.2.4 Joints

AWWA C111/A21.11 for mechanical joints.

2.1.2.5 Plug Valves

MSS SP-78, Type II or IV, Class 125, flanged ends, lubricated.

2.1.2.6 Check Valves

AWWA C508, horizontal or vertical, bronze or resilient seats, gates, and equipped with ball type check.

2.1.3 Miscellaneous Metals

Bolts, nuts, washers, anchors, and supports necessary for the installation of equipment shall be stainless steel, wrought-iron or steel zinc coated in conformance to ASTM A 153.

2.1.4 Concrete

Provide concrete with a 28 day compressive strength of 3,000 psi in accordance with Section 03300, "Cast-In-Place Concrete."

2.2 UNDERGROUND EQUIPMENT ENCLOSURE

Provide equipment chamber having structural strength necessary to withstand transportation and installation without undue buckling, distortion, or other defects. Provide a minimum 7 foot clearance from floor to lowest obstruction to allow disassembly of equipment.

2.2.1 Precast Concrete

ASTM C 478 for circular structures and ASTM C 913 for all other shapes. Provide sump in enclosure floor. Make large enough to contain sump pump. Provide lifting loops within enclosure. Provide entrance lid of plate aluminum, lid and precast cover shall be designed for H-20 vehicle wheel loads. Provide access ladder extending from chamber floor to top of entrance tube. Design ladder in accordance with ANSI A14.3. Zinc-coat steel ladder rungs conforming to ANSI A14.3. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5.

2.3 PUMPING EQUIPMENT

2.3.1 Submersible Sewage Pumps

Provide submersible, centrifugal sewage grinder pumps of the non-clogging type with passageways designed to pass 2 inch diameter spheres without clogging. Design pump to operate in a submerged or partially submerged condition. Provide an integral sliding guide bracket and two guide bars capable of supporting the entire weight of the pumping unit. Attach grinder unit beneath the impeller.

2.3.1.1 Casing

Provide hard, close-grained cast iron casing which is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Design casings to permit replacement of wearing parts. Passageways shall permit the smooth flow of sewage and shall be free from sharp turns and projections.

2.3.1.2 Impeller

Provide non-clogging type cast-iron impeller. Make impeller with smooth

surfaces, free flowing with the necessary clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement will be prevented and reverse rotation will not cause loosening.

2.3.1.3 Shaft and Shaft Seals

Provide shaft of stainless steel. Provide mechanical seal of double carbon and ceramic construction with mating surfaces lapped to a flatness tolerance of one light band. Hold rotating ceramics in mating position with stationary carbons by a stainless steel spring. Oil lubricate bearings.

2.3.1.4 Bearings

Provide heavy duty ball thrust bearing or roller type bearing of adequate size to withstand imposed loads. Oil lubricate bearings.

2.3.2 Pump Motor

Provide a NEMA MG 1, 1750 RPM, 460 volt, 3 phase, and 60 Hz cycle, solid-shaft, submersible, explosion proof squirrel cage induction motor. Motor horsepower shall be not less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor.

2.3.3 Pump Control System

Provide a float switch control system. Design to start pump at indicated high water and stop at indicated low water. Automatically alternate operation from one pump to the other and start second pump in the event first pump cannot handle incoming flow. Provide manual "on-off" switch for each pump. Provide independent adjustable high and low water level switches. Provide high wet well alarm switch.

2.4 ELECTRICAL EQUIPMENT

2.4.1 Control Panel

NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6. Pedestal mount in a protected location. The panel, components, and wiring shall be in accordance with NFPA 70. The enclosure shall meet requirements of NEMA Type 4X construction. Divide control panel into two separate compartments, one to house controls for 120 volt and lower and the other to house higher voltage controls. Circuit breakers, selector switches, and gages shall be front-panel mounted or extended through die-cut openings in the front cover or face plate. No reciprocating or vibrating equipment will be permitted within or mounted on the control panel. Color code internal wiring in accordance with furnished diagrams. Permanently and visibly identify switches, control relays, circuit breaker, and other components, both inside and out. Provide each motor with properly sized, non-reversing, magnetic, across-the-line type starters with overload protection, under-voltage release, and hand-off-automatic selector switch inside of control panel. Include switches for manual operation. Provide a convenience outlet for operation of 110 volt devices. Control panel shall be provided as described in Section 13390, "Package Control Systems."

2.4.2 Wiring

Factory wire station in accordance with NFPA 70. Install wiring from control panel to junction boxes adjacent to equipment in rigid conduit. Install wiring from junction boxes to equipment in flexible conduit, except that accessory items may be plug-connected by insulated service cord to junction boxes. Color code wiring. Wiring subject to flexing during service, such as that from a stationary part to a part mounted on a hinged door, shall be provided with additional insulation at points it is flexed, unless wiring is flexible cord. Install feeder lines from control panel to abovegrade in rigid conduit.

2.4.3 Elapsed Running Time Meter

Provide an elapsed running time meter, totalizing type to register total "on" time in hours, for each pump in the lift station.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Equipment Foundations

Provide foundations and anchorage in accordance with drawings and requirements of the respective equipment manufacturers. When required by the Contracting Officer, obtain from the equipment manufacturer the foundation approval certificate of the design and construction for the equipment involved. Dampen and isolate equipment vibration.

3.1.2 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on any equipment. Match flanges accurately before securing bolts.

3.1.3 Posted Operating Instructions

Provide for packaged lift stations.

3.2 MATERIALS PROTECTION

3.2.1 Painting

Perform painting in the field or shop. However, when touch-up of shop-painted surfaces is required, perform in the manner specified herein.

3.2.2 Metal Surfaces

Coat metal surfaces, except aluminum, bronze, and brass, with a coal tar base conforming to MIL-C-18480, applied in not less than two coats, to a minimum dry film thickness of 40 mils. Before coating, clean metal surfaces of rust, mill scale, oil, grease, dirt, slag, flux, weld spatter, or other foreign substances.

3.3 PUMP LEVEL CONTROL SETTINGS

Set lead and lag pump level controls as indicated on the drawings. Field test settings with clean water prior to system startup.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Performance Testing

In the presence of the Contracting Officer and the field engineer of the manufacturer, test equipment for a minimum of one day. Perform measurement of head test and capacity measurement by head type meter test in accordance with HI SCRRP. Equipment shall be free of cavitation, excess vibration, and over-heating and safety devices shall be demonstrated to perform as scheduled on drawings and specified within control sections of these specifications. Immediately correct discrepancies encountered between specified performance and field performance.

-- End of Section --

SECTION 11325

UV/CHEMICAL OXIDATION SYSTEM

03/97

PART 1 GENERAL

1.1 WORK INCLUDED

- a. This section covers the equipment and installation requirements for a combination ultraviolet light and hydrogen peroxide oxidation system (UV/Oxidation system), which shall include factory assembled reactor, power supply, reagent delivery system, and process control components.
- b. The UV/Oxidation system shall be designed to provide treatment of groundwater to the treatment targets specified herein.
- c. While this specification is particular to UV/Peroxide oxidation, alternate oxidation technologies are encouraged if the contractor submits all necessary information to show an alternative system has a lower annual operation and maintenance cost (O&M) than the technology specified herein, and will be compatible with the treatment plant components. Ozone/Peroxide Oxidation systems and combination UV/Ozone/Peroxide oxidation systems will be considered provided they meet the requirements of this Specification.

1.2 EQUIPMENT NUMBERS

- a. UV/Oxidation System: V-4-1
- b. Peroxide Dosing Units: P-2-1, P-2-2

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. UV/Oxidation System, peroxide dosing units, local control panel, peroxide totes, and appurtenances. G

1.3.1.1 UV/Oxidation System

- a. Provide complete catalog information, descriptive literature, specifications, and identification of materials of construction. Include make, model, dry and operating weight, kilowatt rating, and horsepower of each equipment assembly. Include an annual estimate of operation and maintenance costs and requirements, including all cost components such as electricity, peroxide, lamp replacement, and any other miscellaneous cost items. Include an estimate of the peroxide feed ratio required to meet the treatment requirements listed in this specification.
- b. Submit manufacturer, model, number, and catalog cuts for all instruments furnished with the system, including all accessories

in the control panel.

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G
- c. Electrical and instrumentation details G

1.3.2.1 Layout Drawings

Detailed mechanical and electrical drawings showing equipment fabrications and dimensions, piping layouts, coupling locations, and interfaces with other items.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.2.3 Electrical and Instrumentation Details

Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed. Provide control panel elevation drawings showing construction and placement of operator interface devices and other elements.

1.3.3 SD-06, Instructions

- a. Manufacturer's instructions G
- b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two copies of special shipping, storage and protection, and handling instructions, and two (2) copies of the installation procedures. These instructions shall be furnished to the NTR prior to shipping the unit to the jobsite. Installation instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

Furnish manufacturer's recommended spare parts and special tools required to maintain the UV/oxidation system and peroxide feed systems for one (1) year.

1.3.4 SD-08, Statements

- a. Manufacturer's Certificate of Proper Installation
- b. Treatability Testing Plan G
- c. Peroxide Vendor Statement of Qualifications
- d. Statement of Zero Air Emissions

1.3.4.1 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a legal representative of the UV/Oxidation system manufacturing firm, stating the representative has visually observed the installation, and confirms the system is installed in accordance with manufacturer's written and recommended instructions.

1.3.4.2 Treatability Testing Plan

Lab-scale treatability testing plan for definitive sizing of the oxidation system. Include testing schedule, number of groundwater samples to be collected and tested, sample locations, sampling and sample handling procedures, testing method, and certification of the testing laboratory. Treatability testing has been conducted on Calgon Carbon Oxidation Technology's Model Rayox 30KW system (Calgon Carbon, Markham, Ontario). Treatability testing shall not be required for this specified model.

1.3.4.3 Peroxide Vendor Statement of Qualifications

Submit a statement of qualifications of the proposed hydrogen peroxide vendor. List a minimum of three references for the vendor. Include the location of the peroxide delivery terminal, certification of substance and peroxide purity, and an MSDS sheet for the delivered peroxide.

1.3.4.4 Statement of Zero Air Emissions

It is the intent of this Specification that the selected oxidation system produce near zero air emissions. The vendor shall provide a written statement indicating the estimated hourly and yearly pounds of air emissions from the proposed unit for each constituent air emissions are expected. Oxidation systems may be rejected at the Navy's discretion based solely on a subjective review of the estimated air emissions from the unit.

1.3.5 SD-11, Factory Test Reports

- a. Factory Functional Test Report and log.
- b. Factory Treatability Test Report and log of testing activities.

1.3.6 SD-12, Field Test Reports

- a. Field Performance Testing

1.3.7 SD-19, Operation and Maintenance Manuals

- a. UV/Peroxide Oxidation System, peroxide dosing units, local control panels, and all instrumentation and accessories, data package 4.
G

1.4 STANDARD PRODUCTS

- a. Only equipment of the type specified in this Section which has been in service for a period of not less than three (3) years in a minimum of five (5) installations shall be considered. To show compliance with this requirement, the manufacturer shall provide, with the submittals, a list of similar installations including the date placed in operation and the unit description.
- b. Equipment submitted for approval which does not meet the specified experience period shall be considered if the manufacturer provides

a bond or cash deposit which shall guarantee replacement in the event of failure to comply with the design criteria or to meet the groundwater treatment requirements. The amount of the guarantee bond or cash deposit shall be for 150 percent of the purchase price of the equipment. The time for which the guarantee bond or cash deposit is required shall be equivalent to the warranty period.

- c. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY, HANDLING, AND STORAGE

- a. All equipment shall be delivered, handled, and stored per manufacturer's written instructions. During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.
- b. Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.6 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, any other rotating parts, and any hot equipment components so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.7 NAMEPLATES

Each major equipment component shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, nameplates for the dosing unit pumps shall show the capacity at rated speed in rpm and head in feet of water. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.8 MANUFACTURER'S SERVICES

- a. The manufacturer of the UV/Oxidation system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, testing, and training. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system

visits by the manufacturer's representative shall be coordinated with and approved by the NTR.

b. Services shall include, but not be limited to:

1. Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.

2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations and written instructions, and is ready for permanent operation.

3. Performance testing support as specified hereinafter.

1.9 WARRANTY

Provide an equipment warranty. The equipment manufacturer shall warrant the equipment for a period of 12 months from system startup, or 18 months from shipment, whichever is less.

PART 2 PRODUCTS

2.1 TREATABILITY TESTING

Treatability testing has been conducted on Calgon Carbon Oxidation Technology's Model Rayox 30KW system (Calgon Carbon, Markham, Ontario). Treatability testing shall not be required for this specified model. However, a written guarantee of performance, as described below, shall still be required.

- a. Contractor shall have laboratory-scale treatability testing performed on the proposed oxidation system to definitively size the system to meet the treatment requirements listed in this specification. Testing shall be conducted on groundwater from ABL's alluvial aquifer at Site 1. Contractor shall coordinate with the NTR for collection of the groundwater sample. The contractor shall be responsible for collecting the groundwater sample, in the presence of the NTR, from an existing extraction well(s) selected by the NTR.
- b. Contractor shall be fully responsible for properly shipping the sample to the oxidation vendor laboratory, coordinating testing requirements, and receiving testing results in a timely manner, meeting scheduling requirements. Treatability test shall essentially duplicate field application of the technology, to the NTR's satisfaction.
- c. The end product of treatability testing shall be a written guarantee from the oxidation system vendor indicating the system will meet the treatment requirements listed in this specification. Vendor shall also supply an estimate of the required peroxide dose rate, and an estimate of annual operation and maintenance costs required to keep the system in top operating condition. The submittal shall include the results of the test and type of test.

2.2 PERFORMANCE REQUIREMENTS

- a. The manufacturer shall provide a written guarantee the UV/Oxidation system and equipment shall continuously meet the specified performance requirements under the following conditions:

System Size	: 30 kW
Operating Flowrate	: 220 gpm (for treatment)
Maximum Flowrate	: 250 gpm (hydraulic requirement)
Maximum Inlet Pressure	: 40 psig
Maximum Pressure Drop	: 10 psi at 220 gpm
Effluent Temperature	: 85 deg. F (max)
Power Supply	: 3-phase/60 Hz/480V

The contractor shall note that the system size (30 kW) is based upon treatability testing conducted on Calgon Carbon Oxidation Technology's Model Rayox 30 kW system (Calgon Carbon, Markham, Ontario). Contractor shall determine the final required system size to meet the groundwater treatment requirements based on treatability testing of the proposed system.

- b. The UV/Oxidation system shall be supplied with a minimum electrical capacity to power UV lamps of 30 kW, or as required for alternate systems.
- c. The maximum residual hydrogen peroxide in the effluent from the UV/Oxidation unit shall be 50 mg/l.

2.3 GROUNDWATER TREATMENT REQUIREMENTS

The UV/Oxidation system shall be capable of reducing the compound trichloroethylene (TCE) from an influent concentration of 10 ppm to an effluent concentration of 3 ppm at a flowrate of 220 gpm. UV/Oxidation system shall also provide a minimum TCE removal efficiency of 75 percent at influent concentration up to 30 mg/l. Vendor shall provide a written guarantee that the system meets this groundwater treatment requirement.

2.4 UV/OXIDATION SYSTEM

- a. The manufacturer shall furnish all tools, materials, labor, and appurtenances necessary for the complete fabrication, testing, and shipment of the UV/Oxidation system.
- b. All equipment shall be new and unused, except for final checkout testing.
- c. The UV/Oxidation system shall consist of a skid mounted reactor assembly, power supply, reagent delivery equipment, and programmed process control system. The reactor assembly shall be factory assembled and tested and ready for installation.
- d. The UV/Oxidation system skid shall be capable of completely independent operation.

2.5 REACTOR SKID ASSEMBLY

- a. The reactor skid shall consist of one or more UV reactors, each containing one or more UV lamps. Each lamp shall be protected from the water stream by a quartz cylinder. The reactors shall be

designed for turbulent plug flow behavior to ensure axial mixing for optimum photon absorption and at the same time eliminating short circuiting.

- b. The UV lamps used in the UV/Oxidation reactor shall be specifically designed to provide a broad spectrum of light emission between 200 and 300 nm to maximize photochemical destruction of waterborne pollutants. A minimum of 30 percent of the total lamp output must be below 300 nm. The lamps must be capable of providing 3,000 hours of operation with no more than a 20 percent decrease in emissions in the 200 to 300 nm spectrum.
- c. A cleaning mechanism shall be provided for each quartz tube to maintain efficient transmittance of UV light. The mechanism shall be constructed of materials which are not affected by high intensity UV radiation. The cleaning system must operate automatically with an adjustable time interval. Limit switches must be provided at both ends of wiper travel for fail-safe indication of proper operation. If limit switches are not provided, a UV intensity detector must be provided to ensure the transmittance of UV light through the quartz sleeve. Operation of the cleaning mechanism must not reduce the effectiveness of the treatment.
- d. Sample valves shall be provided on the influent and effluent piping to the reactor.

2.6 POWER SUPPLY

- a. A power supply shall be provided for each UV lamp. The power supply shall be installed in a NEMA 4X ventilated and drip-proof enclosure, and all internal wiring must comply with NEC and be certified by a US OSHA-accredited Nationally Recognized Testing Laboratory (NRTL). Efficiency of the power supply(ies) must be at least 92 percent and the power factor must be greater than 0.9 at full power.
- b. The power supply lamp starting sequence will be set to ensure an extended lamp life, and to minimize inrush starting current.
- c. The power supply system shall be provided with cooling fans, thermal protection, safety access interlock, lamp run meters, lamp ammeters and lamp voltmeters.
- d. The power supply shall be equipped with transformers isolated from ground to provide inherent safety from electrical shock. Ground fault protection is not acceptable as it is not intrinsically safe, and requires periodic checking to ensure continued safe operation.
- e. Each skid shall be wired for a single 480 VAC power drop. A 480 VAC/120 VAC transformer shall be provided to supply low voltage control devices. All control and interlocking circuitry shall be a maximum of 24 VDC.
- f. Maximum allowable load shall be 40 KW.

2.7 UV/OXIDATION REACTOR CONTROL SYSTEM

- a. General: See Section 13390, "Package Control Systems," for general instrumentation and programmable logic controller (PLC) requirements. All instrumentation, control, and electrical components provided under this section shall comply with the requirements of Section 13390, "Package Control Systems." All components shall be prewired to the control panel. Provide all conduit and conductors.
- b. The UV/Oxidation system shall be controlled by a programmable logic controller (PLC) featuring a built-in watchdog timer to ensure integrity of operation. The PLC shall be factory programmed and tested prior to shipment. The PLC shall have sufficient capacity and contacts for control and interface with all standard and optional features and equipment provided with the UV/Oxidation system. PLC memory must be protected by a continuously charged lithium battery in case of power outage. The UV/Oxidation reactor control system shall provide all functions required for complete automatic and manual operation.
- c. The system shall be operated from Local Control Panel LCP-4 with system status and operational data shall be shown on an interface display with an alphanumeric screen. The control system shall permit testing of all equipment while the system is offline for maintenance. This should include, but not be limited to, operation of quartz wiper mechanisms and interlocks, and all reagent pumps.
- d. Each UV/Oxidation skid shall have an individual PLC and control panel to permit completely independent operation.
- e. The control panel shall be NEMA 4 enclosure.
- f. Interlocks shall be provided to alarm and/or shutdown the UV/Oxidation system under the following conditions:
 - High temperature in lamp drive enclosure (alarm and shutdown)
 - Low flowrate (alarm and shutdown)
 - High temperature in the UV/Oxidation reactor (alarm and shutdown)
 - Leak from UV/Oxidation reactor (alarm and shutdown)
 - Lamp failure (alarm and shutdown)
 - High voltage cabinet door is open (alarm)
 - Reactor access covers are open (alarm and shutdown)
 - Quartz wiper failure (alarm)
- g. Provide contact closure outputs for transmitting the following alarms and conditions to the Area Control Panel ACP-1:
 1. SYSTEM ON/OFF STATUS.
 2. General REACTOR FAULT signal for the following conditions:
 - a. High temperature in lamp drive enclosure.
 - b. Low flowrate.
 - c. High temperature in UV/Oxidation reactor.

- d. Leak from UV/Oxidation reactor.
- e. High voltage cabinet door open.
- f. Reactor covers open.
- 3. UV LAMP FAILURE.
- 4. WIPER FAILURE.
- h. Receive dry contact closure input signal from the Area Control Panel ACP-1 for UV/Oxidation system shutdown. Upon receiving this signal, the UV/Oxidation system PLC shall initiate a systematic shutdown and suppress alarms as necessary (e.g., low flow alarm).
- i. The UV/Oxidation system will interface with the telemetry system specified in Section 13401, "Process Instrumentation and Control System," to allow remote monitoring and diagnosis for programming changes to the system.
- j. UV/Oxidation vendor shall be required to supply twenty (feet) of all necessary wiring from the local control panel to a junction box for connection of the UV/Oxidation system to the Area Control Panel ACP-1.

2.8 HYDROGEN PEROXIDE FEED SYSTEMS

2.8.1 Equipment Requirements

- a. Manufacturer shall supply two hydrogen peroxide feed systems (P-2-1, P-2-2). One feed system shall be used primarily to deliver peroxide to the peroxide contact tank, and one feed system shall be used primarily to deliver peroxide to the UV/Oxidation system. The feed systems shall be identical, and shall be piped such that either unit can be used to deliver peroxide to either location.
- b. Each peroxide feed system shall include a metering pump, rotometer, check valve at point of injection, pulsation dampener, electronic solid state low flow switch, and an automatic priming or bleed valve. The operation and speed of the chemical feed pumps shall be controlled by the Area Control Panel ACP-1. Pump stroke shall be manually controlled.
- c. Pumps shall be solenoid-driven, diaphragm metering pumps capable of delivering from 20 to 150 percent of the oxidation vendor's recommended peroxide dosing rate while maintaining an accuracy of plus/minus 0.5 percent.
- d. Pumps shall be capable of delivering peroxide under a discharge head of 60 psig.
- e. Each delivery system shall be skid mounted on an epoxy coated mild steel assembly. Systems shall be mounted remote from the UV/Oxidation system.
- f. Materials: Wetted parts shall be 316 stainless steel, teflon, viton, and polypropylene. Frame and fittings shall be 316 stainless steel.

- g. Electrical Requirements: Each pump shall be suitable for operation on 110 VAC electrical power supply with average power output of less than 15 amps.

2.8.2 Peroxide Feed System Control

- a. Provide contact closure outputs for transmitting the following conditions and alarms to the Area Control Panel ACP-1:
 - 1. System ON/OFF STATUS for each peroxide feed system.
 - 2. System LOCAL/REMOTE control status for each peroxide feed system, indicating whether feed pump is being controlled at the feed system, or by the Area Control Panel ACP-1.
 - 3. Transmit an isolated 4 to 20 mA dc signal to Area Control Panel ACP-1 proportional to the actual pump speed.
 - 4. In REMOTE mode, control peroxide feed system speed and START/STOP from Area Control Panel ACP-1.
- b. Receive input signals from the plant PLC for the following conditions:
 - 1. Receive an isolated 4 to 20 mA dc signal from the Area Control Panel ACP-1 proportional to the treatment system influent flow rate. This analog signal will be used to automatically control the pump speed setpoint based on system flow rate.
 - 2. Receive contact closure input signal from the Area Control Panel ACP-1 for peroxide feed system START/STOP (each system).

2.9 PEROXIDE STORAGE TOTES AND HOSE

- a. Provide three rented peroxide storage totes a maximum of two months prior to system startup. Each tote shall contain 500 gallons of a 50 percent solution of hydrogen peroxide. Totes shall be constructed of type 304L stainless steel and shall be UN/DOT-qualified. Totes shall be delivered with peroxide vendor's certification of the product purity and point of origin of the delivered hydrogen peroxide. Include peroxide vendor's name, address, and phone number on the certification.
- b. Each tote shall have a one-piece sloped bottom with a 2-inch FPT outlet valve to allow complete drainage.
- c. Provide a high-capacity dust filtered breathing vent on each tote, and a large manway on top for ease of inspection.
- d. Provide 304L stainless steel flexible hose for connection to the tote outlet valve. The hose shall connect the peroxide storage totes to stainless steel piping leading to the peroxide feed systems. Provide a vented hose cover for the hose end to prevent contamination when the hose is not in use.

2.10 VALVING

Valving with an internal cavity (such as ball valves) for piping carrying a

50 percent solution of hydrogen peroxide which is provided by the UV/Oxidation vendor shall be drilled on the upstream side to vent the ball enclosure when in the closed position.

2.11 SPARE PARTS AND SPECIAL TOOLS

Furnish manufacturer recommended spare parts and special tools required to maintain the UV/Oxidation system and peroxide feed systems for one (1) year.

2.12 FACTORY TESTING

The UV/Oxidation system shall be tested for satisfactory operation under the proposed operating conditions. The system shall be operated successfully for one hour with no shut downs using clean water. All components of the control system shall be checked to ensure appropriate operation. Certified test results shall be submitted to the NTR.

PART 3 EXECUTION

3.1 INSTALLATION

- a. Install all equipment in accordance with manufacturers' recommended and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.
- b. Contractor shall furnish and install, at the locations shown on the Drawings, a packaged system including field instrumentation, control panel, motors, wiring, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.

3.2 PERFORMANCE TESTING

- a. The UV/Oxidation system shall meet the groundwater treatment requirements specified in Part 2.3, Performance Requirements.
- b. The contractor shall perform field performance testing of the air stripper system to prove the system meets the groundwater treatment requirements. The test solution for influent shall be groundwater spiked with TCE, if necessary, to a total concentration of 10,000 ppb. A minimum of two samples from the influent, and two samples from the effluent shall be taken from the UV/Oxidation system during the one-day test. Analytical costs for the performance testing shall be borne by the contractor. Contractor shall obtain NTR's approval of performance testing plan before any testing or sampling is conducted. Failure of the system to meet the groundwater treatment requirements shall be cause for rejection of equipment.

3.3 CONTROL SYSTEM ACCEPTANCE TESTS

- a. Field test the control system in order to meet the scheduling requirements. Conduct functional acceptance tests (FAT). The objective of these tests are to demonstrate that the control system is operating and complying with the specified performance requirements.

- b. Perform witnessed FATs on the complete control system. Demonstrate each function to the satisfaction of the NTR on a paragraph-by-paragraph basis.
- c. Each test shall be witnessed and signed off by both the NTR and the ROIC.
- d. For each test description include the following minimum information:
 - 1. Specification page and paragraph of function demonstrated.
 - 2. Description of function and test to demonstrate it.
 - 3. Space for sign off and date by the NTR and ROIC.
- e. Notify the NTR at least four weeks prior to the date of the FATs.

3.4 CONTROL SYSTEM RESPONSIBILITY

All components of the control system have been included in this Section so that the contractor will receive a completely coordinated and properly integrated system for efficiency, ease in operation and correct functional relationship among all elements of the system. Therefore, it is the intent of this Specification that the equipment specified under this Section will be furnished by a single vendor. This requires that the UV/Oxidation vendor be responsible for the satisfactory operation of the instrumentation and control system furnished hereunder.

3.5 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for installation assistance.
- b. One (1) person-day for functional testing, initial checks, adjustments, and calibrations, and completion of Manufacturer's Certificate of Proper Installation.
- c. One (1) person-day for pre-startup or post-startup site training of plant operations personnel. Training schedule shall be coordinated with and approved by the NTR.

-- End of Section --

SECTION 11335

LOW PROFILE AIR STRIPPER SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a low profile air stripper system, complete. The low profile air stripper system includes, but is not limited to, one aeration tank and sump, sump differential pressure indicating transmitter which is used to monitor water level and modulate a level control valve on the effluent pump discharge, one blower for the aeration unit, blower accessories, two effluent pumps and accessories, PVC piping, instrumentation, and a local control panel.

1.2 EQUIPMENT NUMBERS

- a. Shallow Tray Air Stripper, V-5-1
- b. Air Blower, B-5-1 (Installed)
- c. Air Blower, B-5-2 (Spare, uninstalled)
- d. Effluent Pumps, P-6-1-1, P-6-1-2

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Shallow tray air stripper G
- b. Sump level control valve G
- c. Air blower and accessories G
- d. Effluent pumps G

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G
- c. Electrical details G
- d. Instrumentation details G

1.3.2.1 Layout Drawings

Detailed mechanical and electrical drawings showing equipment fabrications and dimensions, piping layouts, coupling locations, and interfaces with other items.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.2.3 Electrical Details

Electrical details including blower and effluent pump motor details and electrical wiring diagrams.

1.3.2.4 Instrumentation Details

Instrumentation details including sump level control detail, pressure gauges, level control valve, pressure switches, and local control panel.

1.3.3 SD-06, Instructions

- a. Manufacturer's instructions G
- b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the air stripper, blower, and effluent pump installation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for the air stripper, blower, effluent pumps, and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

- a. Design calculations G
- b. Manufacturer's Certificate of Proper Installation
- c. Statement of Qualifications of Control System Supplier
- d. Testing Plan G

1.3.4.1 Design Calculations

Design calculations for sizing of the air stripper, blower, and effluent pumps, signed and sealed by a registered engineer.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a legal representative of the air stripper system manufacturing firm, stating the representative has visually observed the air stripper installation, and confirms the air stripper is

installed in accordance with manufacturer's written and recommended instructions.

1.3.4.3 Performance Testing Plan

Air stripper system performance testing plan which includes the number of samples to be collected, sample locations, sampling and sample handling procedures, and certification of the testing laboratory.

1.3.5 SD-11, Factory Test Reports

- a. Factory test reports for air stripper system and effluent pumps

1.3.6 SD-12, Field Test Reports

- a. Field testing

1.3.7 SD-19, Operation and Maintenance Manuals

- a. Low profile air stripper system, air blower, and effluent pumps, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its catering.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.8 NAMEPLATES

The air stripper, blower, pumps, and motors shall have a standard nameplate

securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for the blower and each pump shall show the capacity in scfm or gpm at rated speed in rpm and head in inches water column or feet of water as appropriate. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.9 MANUFACTURER'S SERVICES

- a. The manufacturer of the low profile air stripper system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. On-site installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer to contractor, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations, and is ready for permanent operation.
 3. Performance testing support as specified hereinafter.

PART 2 PRODUCTS

2.1 AIR STRIPPER

2.1.1 Performance Requirements

Provide an air stripper which meets all of the following treatment criteria:

<u>Contaminant</u>	<u>Air Stripper Influent Concentration (ug/l)</u>	<u>Required Air Stripper Effluent Concentration (ug/l)</u>
1,1,1-Trichloroethane	250	5
1,1-Dichloroethane	15	0.05
1,1-Dichloroethene	63	0.72
1,2-Dichloroethane	1.5	1.0
1,2-Dichloroethene (Total)	383	13
Chloroform	53	5
Methylene chloride	260	18
Tetrachloroethene	98	19
Toluene	325	14
Trichloroethene	30,000	13
Vinyl chloride	113	12

<u>Contaminant</u>	<u>Air Stripper Influent Concentration (ug/l)</u>	<u>Required Air Stripper Effluent Concentration (ug/l)</u>
Air Temperature:	50 Degrees F	
Water Temperature:	50 Degrees F	
pH:	6.5 to 7.0	
Influent Design Flow Rate:	220 Gal/Min	
Influent Operating Flow Rate:	170 Gal/Min	

The air stripper shall meet all of the required air stripper effluent concentrations at both the design flow rate and the operating flow rate. The air stripper shall also provide a minimum removal efficiency of 99.9888 percent at any influent concentration. If any required effluent concentration is not met at any time during a period of one (1) year after start of operations of the facility controlled by the unit, the contractor shall be responsible for retrofitting or replacing the non-complying unit as required to meet the effluent concentrations specified above.

2.1.2 Air Stripper System Components

The air stripper system consists of the stripper body and internals, collection sump, cover with mist eliminator, blower, effluent pumps, local control panel, and instrumentation.

2.1.2.1 Air Stripper Body

- a. The air stripper shall consist of a countercurrent, stacked-tray, gravity flow system with collection sump. Unit shall be compact with trays mounted above the collection sump. The air stripper body, cover, trays, and sump shall be 304L stainless steel. Trays shall be removable for cleaning with 300 series stainless steel fasteners. Trays shall be interchangeable. Each tray shall be provided with a minimum of one cleanout or inspection port.
- b. The air stripper internals shall include an influent spray nozzle, distributors, and tray internals as required to maintain uniform flow with no short-circuiting. Provide a mist eliminator pack in the air stripper off-gas outlet capable of removing entrained droplets in the air, down to a 10-micron size.

2.1.2.2 Air Stripper Sump and Instrumentation

- a. Provide a sump underneath the air stripper trays. The sump shall provide, at minimum, a working water depth of two (2) feet to allow adequate modulation of the level control valve on the effluent pump discharge which is controlled off of sump water level. Provide a water level sight tube constructed of clear plastic and having gradations at 1/8-inch intervals and numbered at the inch to indicate the depth of water in the sump. Provide a 2-inch drain valve on the sump to enable cleanout. Provide a 24-inch flanged manway on the sump for inspection and cleanout.
- b. Provide a differential pressure indicating transmitter in the sump for level control.

2.1.2.3 Air Stripper System Control Panel

Provide a control panel in accordance with Section 13390, "Package Control

Systems," that includes level control for the air stripper sump water level, control of the blower and effluent pumps, alarm interlocks, relays, motor starters, OOA switches, main disconnect switch, and run lights. Control panel shall be rated NEMA 4.

2.1.2.4 Extra Materials for Air Stripper

Furnish the following extra materials:

- a. Cleaning brush, wand, or manufacturer's standard for tray cleaning.
- b. Complete set of special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those which, because of their limited use are not normally available, but are necessary for the particular equipment.
- c. Spare blower (B-5-2), identical to B-5-1, meeting the requirements of Section 2.2, Blower. Blower shall not be installed, but shall be stored at the Groundwater Treatment Plant Building. Provide all components required for quick installation of blower in the event of primary blower failure.

2.2 BLOWER

2.2.1 Blower Type and Characteristics

- a. The blower shall be capable of providing the required air flow to the air stripper body such that the stripper effluent water meets the required air stripper effluent concentrations listed in this specification. An estimate of 2,400 ACFM at 22 inches water column, requiring a 25 HP motor, has been calculated. The contractor shall determine final air to water ratio, required air flow, horsepower, and discharge pressure requirements for the blower. The blower drive can be either direct or belt-driven. Maximum speed shall be 3,550 rpm.
- b. Blower shall be of the rugged, industrial-duty, centrifugal, maintenance-free, single-stage type, free of contacting moving parts other than motor ball bearings. Blower shall be designed for continuous industrial service, delivering clean air, free of oils or any other contaminants. Blower shall be mounted on the skid with the air stripper system.

2.2.2 Drive Requirements

The motor shall be designed, manufactured, and tested in accordance with the latest revised edition of NEMA MG 1. The motor shall conform to the following:

- | | |
|----------------|--|
| a. Type: | Squirrel-cage induction, single-speed |
| b. Mounting: | Horizontal |
| c. Horsepower: | The motor nameplate horsepower rating shall not be exceeded at any point on the manufacturer's recommended operating curve |
| d. Volts: | 480 VAC |
| e. Phase: | 3-phase |
| f. Frequency: | 60-Hz |
| g. Enclosure: | TEFC |

- h. Service Factor (Min): 1.15
- i. Duty Cycle: Continuous
- j. Bearing Lubrication: Manufacturer's standard

2.2.3 Blower Accessories

- a. Provide an air pressure gauge with a pressure dampener, and a high/low pressure switch on the blower discharge which automatically shuts off the air stripper system in the event of a high or low pressure condition.
- b. Provide blower with an inlet silencer, inlet filter, and flexible connectors, as required and recommended by the blower manufacturer, for proper operation. Provide lifting lugs for ease of handling. Provide a butterfly valve on the blower discharge for flow throttling.

2.3 EFFLUENT PUMPS

2.3.1 Pump Type

The effluent pumps shall be horizontal end suction centrifugal pumps meeting the requirements of ANSI/ASME B73.1M, and designed for the configurations and capacities listed below.

2.3.1.1 Pump Characteristics

- a. The effluent pumps are sized based on the following conditions used in the preliminary hydraulic analysis. It shall be the responsibility of the contractor to confirm and provide a final pump size based on the piping and equipment arrangement of the final design.

Operating Flow Rate:	170 Gal/Min
Design Flow Rate:	220 Gal/Min
Total Dynamic Head:	174 Feet at 220 Gal/Min

- b. The effluent pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered. Pumps shall be capable of operating efficiently at both the operating and the design flow rate.

2.3.1.2 Pump Drives

The effluent pumps are estimated to require the following drive units and shall be directly connected to the drive units through solid shafts. It shall be the contractor's responsibility to confirm the final drive size based on the head and flow characteristics of the pump. Associated changes in electrical facilities resulting from adjusted drive sizes shall be completed by the contractor. Motor starters shall be mounted in Local Control Panel LCP-5.

Rated speed:	1,750 rpm
Rated horsepower:	25 hp, maximum
Rated voltage:	480 VAC
Phase:	3

2.3.1.3 Pump Piping Connections

The pump suction and discharge shall be provided with flanged connections of suitable size and suitably arranged for piping shown. Pipe flanges shall conform to ASME B16.1 and ASME B16.5. Piping shall be installed to preclude the formation of air pockets. Provide eccentric reducers as necessary to make pump connections compatible with piping arrangement shown.

2.3.1.4 Pump Finish

Pumps shall have rust-inhibiting painted or enameled finish as is standard with the manufacturer.

2.3.1.5 Pump Instrumentation

- a. Provide a pressure gauge with a pressure dampener, and swing check valve on the discharge from each pump. Pressure gauges shall be in accordance with Section 13000, "Instrumentation Components." Valves shall be in accordance with Section 15100, "Valves and Operators."
- b. Provide a pneumatically actuated globe valve for air stripper sump level control on the effluent pumps' discharge manifold. Valve and actuator shall conform to the requirements of Section 15100, "Valves and Operators."

2.3.1.6 Extra Materials for Pump

Furnish the following extra materials for the pump:

- a. Complete set of packing.
- b. Complete set of bearings.
- c. Complete set of gaskets and O-ring seals.
- d. Complete set of shaft sleeves.
- e. Complete mechanical seal.
- f. One complete set of any special tools required to dismantle pump. Special tools are considered to be those tools which, because of their limited use are not normally available, but which are necessary for the particular equipment. All tools shall be delivered at the same time as the equipment to which they pertain.

2.4 FUNCTIONAL DESCRIPTION

- a. The following functional descriptions describing the operations of the air stripper system will be considered the essence of the specifications. Furnish and install all necessary equipment, instruments, software modules and appurtenances to achieve the performance as hereinafter described, even though such items may not be included in any specific listing of equipment furnished. An involved system of this nature requires emphasis on the functional aspects of the Specifications while the technical details serve to indicate the desired manner in which the end result will be accomplished.
- b. The electrical control system shall consist of a Control Panel (LCP-5) and external input devices to operate the air stripper

system automatically and protect equipment and the treatment process from fault conditions. The control panel shall be a NEMA 4 enclosure containing power and control devices suitable for operating the air stripper system, blower, and effluent pumps in accordance with the Drawings. Fabrication shall be performed by a UL approved shop experienced in the fabrication of industrial control panels.

- c. Power shall be three phase 480 volts. Devices (including motors) shall be sized accordingly. The panel shall contain external operated disconnect switch and overload reset button, branch fusing and motor control for blower and effluent pumps. Motor starters shall contain IEC style overload relays for thermal overload protection, and contain a differential tripping mechanism for phase fault protection. Motor starters for the blower and effluent pumps shall be contained in LCP-5. Provide transformer for control circuitry.

d. Functional Requirements:

1. Blower shall be controlled by ON/OFF/AUTO selector switch on LCP-5.
2. Effluent pumps shall be controlled by ON/OFF/AUTO selector switch on LCP-5. One effluent pump shall be allowed to operate at a time. If the operating pump fails, switching to the second pump shall be a manual operation.
3. Air stripper system shall shut down on either blower discharge HIGH or LOW PRESSURE and require manual RESET to restart blower and effluent pump. Pressure switches shall be set per manufacturer's recommendation.
4. Upon operator-initiated shut down, the blower shall continue to operate for a period of thirty (30) seconds before automatically shutting down.
5. A differential pressure indicating transmitter located in the sump shall monitor water level. A pneumatically actuated level control valve shall be provided on the effluent pumps' discharge. The pressure signal shall be used to modulate the position of the level control valve to maintain a pre-determined water level in the sump.
6. The air stripper system shall shut down upon sump HIGH HIGH or LOW LOW LEVEL and require manual RESET to restart the blower and effluent pump.
7. The air stripper system shall shut down upon effluent pump FAIL WHILE RUNNING and require manual RESET to restart blower and effluent pump.
8. Receive dry contact closure for SYSTEM SHUTDOWN from the Area Control Panel ACP-1, and STOP.
9. Provide dry contact closure for air stripper system COMMON FAULT signal to the Area Control Panel ACP-1. COMMON FAULT includes: sump lowlow level, sump high high level, effluent pump fail to start, fail while running, air blower low pressure, and

air blower high pressure.

- e. Operator Interfaces: Furnish operator interfaces and indicating lights on the control panel as follows:
 - 1. Blower HIGH and LOW pressure indicating lights.
 - 2. Sump HIGH HIGH and LOW LOW level indicating lights.
 - 3. Effluent pump FAIL TO START and FAIL WHILE RUNNING indicating lights.
 - 4. Blower ON/OFF/AUTO selector switch.
 - 5. Blower ON indicating light.
 - 6. Effluent pumps ON/OFF/AUTO selector switches (each pump).
 - 7. Effluent pumps ON indicating lights (each pump).
 - 8. RESET pushbutton.

2.5 FACTORY TESTING

2.5.1 Air Stripper

The air stripper system shall be tested for leaks under the proposed operating conditions using clean water, to ensure the trays and sump are free from cracks and other imperfections. The air stripper shall be operated for one hour and a soap solution shall be applied to positively locate leaks and imperfections. All such leaks and imperfections shall be corrected and the unit shall be retested. Certified test results shall be submitted to the NTR.

2.5.2 Effluent Pumps

Pump shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Only one pump shall be tested, and the testing shall be used to determine the adequacy of the untested pump. Certified test results shall be submitted to the NTR.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

- a. Install all equipment in accordance with manufacturers' printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.
- b. Contractor shall furnish and install, at the locations shown on the Drawings, a packaged system including field instrumentation, control panel, motors, wiring, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.

3.1.2 Additional Effluent Pump Installation Requirements

- a. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.
- b. Connect suction and discharge piping without imposing strain to pump flanges. Provide pipe supports at connections so the piping weight is not being supported on the pump.

3.2 PERFORMANCE TESTING

- a. The air stripper system shall meet the air stripper effluent concentrations specified in Part 2.1.1, Performance Requirements.
- b. The contractor shall perform field performance testing of the air stripper system to prove the system meets the required effluent limits. The test solution for influent shall be groundwater spiked with TCE, if necessary, to a total concentration of 10,000 ppb. A minimum of two samples from the influent, and two samples from the effluent shall be taken from the air stripper system during the one-day test. Analytical costs for the performance testing shall be borne by the contractor. Contractor shall obtain NTR's approval of performance testing plan before any testing or sampling is conducted.

3.3 CONTROL SYSTEM ACCEPTANCE TESTS

- a. Field test the control system in order to meet the scheduling requirements. Conduct functional acceptance tests (FAT). The objective of these tests are to demonstrate that the control system is operating and complying with the specified performance requirements.
- b. Perform witness, FATs on the complete control system. Demonstrate each function to the satisfaction of the NTR on a paragraph-by-paragraph basis.
- c. Each test shall be witnessed and signed off by both the NTR and the ROIC.
- d. For each test description include the following minimum information:
 1. Specification page and paragraph of function loop demonstrated.
 2. Description of function or loop and test to demonstrate it.
 3. Space for sign off and date by the NTR and ROIC.
- e. Notify the NTR and the Control System Supplier at least four weeks prior to the date of the FATs.

3.4 CONTROL SYSTEM RESPONSIBILITY

- a. All components of the control system have been included in this Section so that the contractor will receive a completely coordinated and properly integrated system for efficiency, ease in

operation and correct functional relationship among all elements of the system. Therefore, it is the intent of this Specification that the equipment specified under this Section will be furnished by a single Control System Supplier. This requires that the Control System Supplier be responsible for the satisfactory operation of the instrumentation and control system furnished hereunder.

- b. An acceptable Control System Supplier shall provide the following minimum materials and services:
 - 1. Design, assemble, furnish, and supervise installation of major components of the control system.
 - 2. Check final power and signal connections.
 - 3. Adjust, tune, and calibrate system.
 - 4. Examine and, if required, coordinate modification of existing signals, wiring, or connections from the Area Control Panel ACP-1 for compatibility into the control system.
 - 5. Verify complete compatibility of existing wiring, signals, connections, with control system.
 - 6. Provide the advice, diagnosis and/or repair of control system during the warranty period.
- c. Provide all materials and services listed immediately above at no additional cost.

3.5 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for installation assistance.
- b. One (1) person-day for functional and performance testing and completion of Manufacturer's Certificate of Installation.
- c. One (1) person-day for pre-startup or post-startup site training of plant operations personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been approved by the NTR.

-- End of Section --

SECTION 11350

LIQUID-PHASE CARBON SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a liquid-phase carbon system for the destruction of residual hydrogen peroxide, complete. The system includes, but is not limited to, one carbon containment pressure vessel operated in an upflow mode, internals for carbon retention, catalytically active virgin granular activated carbon (GAC), and piping and valving for influent and effluent water, carbon transfer, pressure relief, and utility air and water connections.

1.2 EQUIPMENT NUMBERS

- a. Carbon Vessel, V-7-1

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Liquid-Phase Carbon System G

1.3.1.1 Liquid-Phase Carbon System

Provide catalog information including vessel specification and design pressure, design flow rate, pressure drop at operating and design flow rate, contact time, dimensions, and carbon capacity. List the mass of carbon to be held in the bed, and the area and depth of the activated carbon bed. Provide manufacturer's specification of granular activated carbon (GAC) to be utilized in the system. Provide recent lot laboratory analyses results to demonstrate that GAC supply is in accordance with manufacturer's published specifications. Provide manufacturer's description of adsorber vessel GAC loading and removal procedures for system.

1.3.2 SD-04, Drawings

- a. Layout drawings G

1.3.2.1 Layout Drawings

Detailed mechanical drawings showing equipment fabrications, dimensions and weights, materials of construction, piping layouts, connection sizes, types, and locations, nozzle orientations and details, and interfaces with other items. Show all valving and instrumentation components. Include details of air release, pressure relief, and vent valving, and valving for GAC loading/unloading. Provide a flow diagram of system valving procedures.

1.3.3 SD-06, Instructions

a. Manufacturer's instructions G

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the adsorption system installation/operation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, and operating details including carbon transfer instructions. Failure to furnish these installation procedures may be cause for rejection of the equipment. The installation instructions shall be specific to upflow operation of the model supplied.

1.3.4 SD-08, Statements

a. Design calculations G

b. Manufacturer's Certificate of Proper Installation

c. Carbon Testing

1.3.4.1 Design Calculations

Design calculations of surface loading (gallons per minute per square foot of bed cross-sectional area) and empty bed contact time (minutes) at operating and design flows, signed and sealed by a registered engineer.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a legal representative of the GAC system, stating the representative has visually observed the installation, and confirms the GAC system is installed in accordance with manufacturer's written and recommended instructions.

1.3.5 SD-19, Operation and Maintenance Manuals

- a. Provide O&M manuals for the liquid-phase GAC system, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in

enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 NAMEPLATES

The carbon vessel shall have a nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate shall list the maximum design flow rate, the carbon charge contained in the vessel (pounds and cubic feet), and the mode of operation (upflow). Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.8 MANUFACTURER'S SERVICES

- a. The manufacturer of the GAC system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations, and is ready for permanent operation.
 3. Training in the operation and maintenance of the carbon system, focusing on carbon transfer operations.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- a. The GAC system shall be designed for a minimum removal of 90 percent of the influent hydrogen peroxide to the system. The influent hydrogen peroxide concentration (50% solution) is expected to be 25 mg/L.

2.2 CARBON VESSEL

2.2.1 Vessel Requirements

- a. The carbon vessel shall have suitable dimensions to fit in the available space shown on the Drawings, while providing a minimum of three (3) feet clear space around all sides of the vessel, including piping and valving accessories. The vessel shall be a

vertical, cylindrical pressure vessel with flanged connections and dished ASME Code top and bottom heads. The vessel dimensions shall be approximately six feet in diameter by nine feet of straight side shell height. The contractor shall provide final vessel dimensions based on the selected vendor. Vessel shall be skid-mounted.

- b. The carbon unit shall operate in an upflow configuration. Influent shall enter near the bottom of the vessel, and effluent shall leave the vessel from the top. In the vessel, residual hydrogen peroxide will be destroyed, releasing oxygen bubbles. Oxygen bubbles will be released from the unit using an air release valve located on the top of the vessel.
- c. The carbon vessel shall be designed and constructed to hold 5,000 pounds of catalytically active carbon, provide an empty bed contact time of 5 minutes at 220 gpm and a surface loading of between 6 and 8 gpm/sf. Bed expansion due to upflow operation shall be limited to 35%.
- d. The carbon adsorber vessel shall be shop-fabricated of carbon steel, conforming to ASTM A516 grade 70, with 2:1 elliptical top and bottom heads. The vessel shall be designed, constructed, and stamped in accordance with ASME Section VIII and registered with the National Board for a design pressure rating of 125 psig at 140 degrees F. Provide one (1) 14" X 18" elliptical manway located on the lower straight side portion of the vessel. Provide one (1) 24" circular manway located on the top of the vessel. The vessel will be free standing with four (4) structural steel support legs. The carbon vessel shall be provided with a drain valve at the bottom.
- e. Vessel shall have all welds and any other sharp edges ground smooth, and all imperfections such as skip welds, delaminations, scabs, slivers, and slag shall be corrected prior to surface preparation and painting.

2.2.2 Lining and Painting

2.2.2.1 Surface Preparation

All surfaces will be degreased prior to sandblasting. The adsorber internal surface that will be lined will be blasted to a white metal surface (SSPC-SP5) to provide a 3 to 4 mil anchor pattern. The exterior of the adsorber will be power towel cleaned to the degree specified by SSPC-SP-63.

2.2.2.2 Lining

The interior of the adsorber vessel shall be lined with a nominal 25 to 35 MDFT Wisconsin Protective Coatings Plastic, 4000 Series, lining material. The coating material shall meet the requirements of U.S. Federal Register, Food and Drug Regulations, Title 21, Chapter 1, Paragraph 175.300.

2.2.2.3 Painting

The exterior surface of the adsorber shall be painted to 10 to 12 MDFT with an epoxy mastic (gray color) paint material.

2.2.3 Process/Utility Valving and Instrumentation

All valves in this section shall be provided in accordance with Section 15100, "Valves and Operators."

- a. Provide an air release valve, located on top of the carbon vessel, sized by the carbon manufacturer based on the production of oxygen from the destruction of residual peroxide.
- b. Provide carbon fill and carbon discharge valves, which are full port ball valves, 316 stainless steel construction with TFE seats and seals. A total of four (4) valves shall be supplied. Two (2) for carbon fill, and two (2) for carbon discharge.
- c. Compressed air valves shall be bronze or forge brass or barstock brass body regular port ball valves.
- d. Pressure relief valve: Provide a rupture disk constructed of impervious graphite and designed to relieve pressure at 75% of the vessel's design pressure rating. Discharge from the pressure relief valve shall be piped to the floor drain.
- e. Pressure gauges: Provide influent and effluent process piping with pressure gauges to indicate the pressure of water entering and exiting the carbon vessel. The pressure gauges shall have a 4-1/2" face diameter with a pressure range of 0 to 150 psig. Pressure gauges shall be provided in conformance with Section 13000, "Instrumentation Components."
- f. Transfer hose connectors: The carbon supply piping shall be fitted with hose connectors, such that carbon transfer to and from the carbon vessel can be facilitated with carbon transfer hoses. These connectors shall be 4" Quick Disconnect Adapters constructed of Nylon.
- g. Flush connections: Two (2) flush connections shall be provided on the carbon supply line, and one (1) flush connection downstream of the carbon discharge valve.

2.3 CATALYTICALLY ACTIVE CARBON REQUIREMENTS

- a. Carbon shall be virgin liquid-phase catalytically active carbon produced from bituminous coal, and formulated specifically for the catalytic destruction of hydrogen peroxide in water. The carbon shall be capable of being reactivated for recycle and/or reuse.
- b. The carbon vessel shall be factory filled with virgin liquid-phase catalytically active carbon meeting the following specifications:

Peroxide Number:	14 max
Iodine Number, mg/g:	800 min
Ash, by weight %:	8 max
Moisture, by weight % as packed:	2 max
Abrasion Number:	75 min

Apparent Density, g/ml: 0.58-0.62 min

Mean Particle Diameter: 0.9-1.1 mm

U.S. Sieve Series:

Percent on 12 mesh: 5 max

Percent on 40 mesh: 4 max

PART 3 EXECUTION

3.1 INSTALLATION

- a. Install equipment in accordance with manufacturers' printed instructions and recommendations. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.
- b. Contractor shall furnish and install, at the locations shown on the Drawings, a packaged system including field instrumentation, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.
- c. Provide pipe supports at all piping connections, as required, so the piping weight is not being supported by the carbon vessel.

3.2 CARBON TESTING

Each lot of delivered activated carbon shall be accompanied by an analysis sheet listing each of the measured characteristics of the required parameters in this specification. A random sample shall be selected by the NTR for testing to ensure product quality. Laboratory analyses in support of product quality testing shall be borne by the contractor. If the laboratory analysis reveals the tested carbon fails to meet the Specifications, the carbon shall be replaced at the contractor's expense.

3.3 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for installation assistance, inspection, certification of the installation, and startup/carbon transfer site training.

-- End of Section --

SECTION 11360

SLUDGE DEWATERING SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a sludge dewatering system which consists of, but is not limited to, a plate and frame filter press, air diaphragm pump, filter press plate washing pump, filter cake dumpster, and control panel.

1.2 EQUIPMENT NUMBERS

- a. Plate and Frame Filter Press: F-11-1
- b. Filter Press Feed Pump: P-11-1
- c. Filter Press Plate Washing Pump: P-11-2

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Plate and frame filter press, control panel, filter press feed pump, filter cake dumpster, and related accessories G

1.3.1.1 Manufacturer's Catalog Data

Include manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction. Include performance data showing compliance with specification requirements. Include pump curves showing head, air supply pressure, air consumption, and capacity over the entire operating range.

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G
- c. Electrical details G
- d. Instrumentation details G

1.3.2.1 Layout Drawings

Detailed mechanical and electrical drawings showing equipment make, model, weight, fabrications, and dimensions, piping layouts, coupling locations, and interfaces with other items. Show mounting requirements. Include details of the hydraulic system, hydraulic cylinders. Include schematics of valving, piping, and control devices.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.2.3 Electrical Details

Electrical details including pump motor details and electrical wiring diagrams.

1.3.2.4 Instrumentation Details

Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed. Include control panel elevation drawings showing construction and placement of operator interface devices and other elements.

1.3.3 SD-06, Instructions

a. Manufacturer's instructions G

b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the equipment installation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for all equipment components, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

a. Manufacturer's Certificate of Proper Installation

1.3.5 SD-11, Factory Test Reports

a. Factory Testing of the Sludge Dewatering System

1.3.6 SD-12, Field Test Reports

a. Field Testing

1.3.1 SD-19, Operation and Maintenance Manuals

a. Provide O&M manuals for the filter press and control system, and sludge feed pump, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer

regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Materials shall be protected to the satisfaction of the NTR. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.8 MANUFACTURER'S SERVICES

- a. The manufacturer of the filter press system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer to contractor, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations and printed instructions, and is ready for permanent operation.
 3. Post-startup assistance and sludge processing training since sludge will not be available prior to startup.

PART 2 PRODUCTS

2.1 FILTER PRESS

2.1.1 Filter Press Requirements

The filter press shall be designed to efficiently dewater metal hydroxide sludge and suspended solids generated from the treatment of groundwater. The press shall include all components necessary for a complete operating unit. Integrally incorporated with the filter press system shall be a filter-press mounted control panel, including automatic pump control system and a 115-volt transformer. The filter press shall be supplied with the following components:

Automatic core blow and filtrate blow valves
Polypropylene, gasketed recessed chamber plates
Fabricated steel skeleton
Automatic, pneumatic-hydraulic opening and closing system
Filter press controls
Sidebar plate suspension system
Air blow/precoat manifold

2.1.2 Design Criteria

Design Operating Pressure:	100 psig
Total Volume (per cycle):	10 cubic feet
Total Filtration Area:	268 square feet
Plate Size:	830 X 830 mm
Number of Chambers:	26
Cake Thickness:	1-inch
Volume per Chamber:	0.39 cubic feet
Filtration Area per Chamber:	10.33 square feet

2.2 EQUIPMENT DESIGN REQUIREMENTS

2.2.1 Filter Plates

- a. Filter plates shall be of the center feed, alternating corner discharge design for operation at 100 psig pressure at ambient temperature. Plates shall be of the gasketed design. Gasketing shall be on the perimeter sealing surface and around each of the corner eyes. Plates shall come complete with filter cloths installed.
- b. Recessed plates shall be molded from virgin, gray polypropylene and shall contain no fillers. Plates shall have a drainage surface design that shall provide adequate support for filter cloths and shall have integrally molded stayboss supports equally spaced on the drain field. Plate sealing surfaces shall be machined to a maximum parallel plane tolerance of 0.3 mm. Chamber recess depth dimension shall have a tolerance not to exceed 0.5 mm.
- c. Plates shall have a round bottomed caulking groove machined around the perimeter of each drainfield for installation of filter cloths. Grooves of the dovetail design shall be machined around each corner port and around the cake chamber on the sealing surface for the installation of gasketing.
- d. Filter cloths shall be made of polypropylene fabric. Fabric shall

be heat set and calendared. Cloths shall have a monofilament warp and a multifilament fiber weave. Cloths shall have a satin design weave. Minimum cloth weight shall be 9 oz./yd. Cloths shall have a porosity of 4 SCFM as measured on the Frazier scale. Cloths shall be of the barrel neck design. Neck material shall be of the same or less porous material.

- e. Cloths shall be held in place on the filter plates by a woven, high density polypropylene cord sewn into the perimeter of the cloth. It shall be pressed or caulked into place on the filter plate and held there by an interference fit.
- f. Gasketing shall be molded of EPDM elastomer compound and shall be of the O-ring type design. Gasketing shall have a minimum 70A durometer hardness.
- g. Backup Plate: A blank plate or backup plate shall be provided which can be inserted at any point in the stack with the tail plate to run a partial filter press load. The blank plate isolates all filter plates between it and the follower.

2.2.2 Filter Press Skeleton

- a. The filter press skeleton and related sub-components shall be designed to maintain the filter pack in a closed position against an internal operating pressure of 100 psi plus a minimum clamping factor of 25% greater than the maximum internal operating pressure multiplied times the filter area of the tail filter plate. Minimum closure force shall be 28 tons.
- b. The filter press frame shall be fabricated of ASTM-A36 carbon steel plate and structures. All weldments shall be designed to evenly distribute the operational forces developed during filtration over the entire component. All components shall be designed with a minimum safety factor of 1.5 times the maximum closure force. All edges and welds shall be deburred and ground smooth. All weld splatter, weld slag and mill scale shall be removed before painting.
- c. Two side bars of hot rolled steel shall connect the head and cylinder bracket at the horizontal centerline of the plate pack so as not to interfere with cake discharge. Each connection point shall be designed with a minimum safety factor of 1.5 times the maximum closure force.
- d. The side bars shall be of sufficient size and weight to support the full operational weight of the filter plate pack including the follower head, plate pack and filter cake with a maximum deflection of 1/900 of the length of the filter press assembly.
- e. To prevent corrosion of the sidebars due to surface finish erosion, the side bars shall come complete with 304 stainless steel wear strips on the contact surface with plate suspension handles and follower head rollers.
- f. The follower head sub-assembly shall be suspended from the side bars.
- g. All non-stainless steel metallic surfaces shall be finished for

maximum corrosion resistance in accordance with the following:

1. Surface Preparation: Blast to SSPC-10, near with metal blast cleaned surface.
2. Primer: One coat, two component, chrome free, low VOC polyurethane primer at 1.2 to 2 MDFT.
3. Finish: Two coats, single stage, two component acrylic urethane at 1.5 MDFT each coat.

2.2.3 Hydraulic Cylinder

The hydraulic cylinder shall be capable of producing 28 tons of clamping pressure at an hydraulic input pressure of 4500 psig. The cylinder shall have a 4.00 inch diameter bore and an 18 inch stroke to provide a filter pack cake discharge cleanout space of 16 inches. The cylinder shall be of the tie rod design for ease of servicing hydraulic seals. The piston rod shall be covered by a flexible neoprene bellow to protect the rod from contamination. The piston rod shall be connected to the follower head by means of a rod eye and clevis arrangement that allows follower head movement only in a vertical plane perpendicular to the length of the press.

The rod eye and clevis shall be equipped with grease fittings. The cylinder, rod eye and clevis shall be designed with a minimum safety factor of 3.0 times the maximum cylinder capacity.

2.2.4 Feed and Discharge Piping

- a. Feed and discharge piping shall be supplied by the manufacturer. Piping shall be fabricated of schedule 80 PVC providing the connections through the head from the center feed slurry port and the corner filtrate discharge ports in the filter pack through the stationary head. All threads shall be NPT standard.
- b. Provide air blowdown manifold for core blow. The air blowdown manifold shall be factory piped and wired, and shall consist of the necessary piping and valves to join the four filtrate discharge ports into a common discharge pipe. Closing of the valves and introducing air into the upper filtrate port shall force air through the filter cake in each chamber of the press. A 0- to 60-psi air regulator and air pressure gauge to control and monitor air blowdown shall also be supplied.

2.3 VALVES

- a. The filter press manufacturer shall furnish all valves used within the filter press system. Valves shall be of the type and size as required by the process, and shall be complete with all necessary operating appurtenances that are required for safe, automatic, and efficient operation.
- b. Sludge valves shall be the eccentric plug type. Provide the nonlubricated type, drip-tight shutoff, cast iron body with flanged ends. Plug shall be cast iron with round or rectangular port of no less than 80 percent of connecting pipe area and coated with Buna-N or Hycar. Seats shall be stainless steel or nickel.

2.4 FILTER CAKE DUMPSTER

One carbon steel filter cake dumpster shall be furnished. Dumpster capacity shall be a minimum of 9.5 cubic feet. Dumpster shall have large, ball-bearing casters for easy positioning under the press, which may be done by hand or by a lift truck. When filled, the dumpster shall be designed to be picked up with a lift truck and positioned over a large disposal receptacle. The pulling of a pin shall allow the unit to self-dump, requiring no hand shoveling. Dumpster shall have manufacturer's standard finish.

2.5 FILTER PRESS FEED PUMP

Filter press feed pump shall be of the same manufacturer as the Dewatering Aid Transfer Pump specified in Section 11380, "Dewatering and Feed System."

- a. Filter press manufacturer shall furnish one (1) air-operated, double-diaphragm type filter press feed pump with all ancillaries needed to operate the filter press. Pump shall be capable of pumping a minimum of 15 gpm at 100 psig. Contractor shall be fully responsible for sizing and selecting the pump to meet the filter press head requirements determined during final system design.
- b. Pump shall consist of a pump body with cover and base tee, diaphragm with compression spring assist on suction fill cycle, inlet and outlet ball valve-type checks, extra heavy duty air discharge muffler/silencer, air pressure regulator, air-lubricating filter, and plugged gauge cocks. Air consumption discharge shall be piped and vented to the exterior of the building.
- c. Pump shall be capable of starting and stopping at least 20 times per minute without subsequent damage to the pump or associated equipment, and shall be capable of running dry without damage to wearing parts. Pump shall be self-priming.
- d. Pump Bodies:
 1. Pump bodies, including covers, base tees, and spools, shall be cast iron. Wetted portions of the pump housing subject to the process fluid shall be aluminum.
 2. The entire assembly shall be capable of sustaining the vacuum and pressure loads imposed by the operating conditions described. Pump covers shall be provided with drilled and tapped holes for pressure air connections.
- e. Diaphragms shall be Buna-N or Geolast abrasive-resistant, and shall serve as a gasket between the bodies and covers.
- f. Check valves and seats shall be Buna-N or Geolast. Seats shall be replaceable.
- g. Provide one surge suppressor on the pump discharge, sized by the manufacturer for the operating conditions described herein. Suppressor shall have polypropylene body with Buna-N elastomers and shall have a flanged connection suitable for mounting to a tee.
- h. Pump actuation shall be controlled by an integral, externally serviceable air valve. The air valve shall consist of only one

moving part which shifts without mechanical assistance (i.e., springs, pilot valves) and which is capable of operating without lubrication. The internal air valve and center section components shall be manufactured materials exhibiting self lubricating characteristics insuring extended wear life in a non-lubricated environment.

- i. Air Set: Provide pressure regulator, solenoid valve, and needle valve on air supply line to the feed pump for control of pressurized air supply to the pump.

2.6 SPARE PARTS AND SPECIAL TOOLS

- a. Filter Press: Provide two spare plates, spare set of filter cloths, and gaskets equal to the number of chambers and any special tools needed for regular operation or dismantling of the filter press.
- b. Filter Press Feed Pump: One spare diaphragm, one spare check valve ball, one complete set of valve seats, one spring assembly, and any special tools required to dismantle the pump.

2.7 PLATE WASHING PUMP

One portable, high pressure cloth washer shall be furnished. The washer shall be mounted on wheels and shall have a minimum of 30 feet of discharge hose on a reel, and 10 feet of suction hose. A high pressure booster pump included in the washer shall deliver 4 gpm at a pressure of 2,000 psig. The pump shall be driven by a 460 volt, three-phase, 60-Hz, 5 hp motor. The cloth washer shall be furnished with 30 feet of power cord with no plug. The high pressure water shall be discharged through a spray wand with a trigger-type mechanism to start/stop the flow. The pressure washer power cord shall be connected to a disconnect switch at the building wall adjacent to the filter press.

2.8 CONTROL SYSTEM

- a. Provide a filter press Local Control Panel (LCP-11) in accordance with Section 13390, "Package Control Systems." Local control panel shall be 120 volt. The filter press control panel shall be mounted within the filter press hydraulic cabinet and shall contain all necessary switches, gauges, valving and tubing. The panel shall come complete with selector switches for the following functions:
 1. Filter press, open/close
 2. Hydraulic pump, on/off
- b. An automatic feed pump control system shall be supplied and mounted on the filter press. Control panel shall be NEMA 4. The automatic feed pump control system shall be designed to sequence the start-up of an air-operated diaphragm feed pump by 25 psi increments. An air pressure switch mounted on the pump air exhaust shall activate each time the sludge pump strokes. The feed pressure shall advance to the next stage when the time between pump strokes equals a field adjustable setpoint, thereby automatically adjusting to variations in the feed slurry concentration and filtration characteristics. The control shall

visually signal when the press cycle is complete by sensing the duration between pump strokes and illuminating a "cycle over" lamp. The control system shall also include a low hydraulic pressure safety shut down circuit designed to interrupt the air supply to the feed pump in the event of loss of hydraulic closure pressure.

c. Operator Controls and Indicators:

1. Control power ON/OFF switch and indicator light.
2. Air diaphragm pump discharge pressure indicators.
3. Pressure cycle running time meter.
4. Air feed line to pumps pressure indicator.
5. Pressing cycle ON pushbutton for feed start.
6. Hydraulic pressure LOW indicator light.
7. PRESS FULL indicator light.

d. Functional Requirements: The control system shall provide all functions required for manual initiation of filter press cycle and automatic operation of all filter press functions during the cycle. Provide the following functions:

1. Sequence the control of all equipment including air solenoid valve, pneumatically actuated hydraulic pump, control valves, and other auxiliary equipment.
2. Upon operator initiation of the cycle, the pump air valve shall automatically adjust pressure sequentially until terminal pressure is reached. At that time, the PRESS FULL indicator light shall illuminate.
3. At the initiation of the air blowdown cycle, the control system shall automatically control the valve sequencing for air core blowdown.
4. Provide a low-hydraulic pressure safety shutdown circuit which shall shut down the air diaphragm pump in the event of low hydraulic pressure.
5. Provide air pressure regulators as required to automatically increase pump pressure during filter cycle and control air blowdown cycle.

2.9 ACCESSORIES

- a. Equipment weighing over 100 pounds shall be provided with lifting lugs.
- b. Provide all baseplates required to fasten equipment to the building, floor slab, or equipment pads.
- c. Identification plates: Securely mount on the filter press, pump, and portable plate washer in a readily visible location. The

nameplate shall be 16-gauge, Type 316 stainless steel, and shall bear the 1/4-inch die-stamped lettering. The nameplate shall include, as a minimum, the equipment number assigned in this specification, capacity, manufacturer's name, make, and model.

2.10 FACTORY TESTING

a. Mechanical:

1. Hydraulic Clamping System: After hydraulic clamping system has been installed on the press, test at full pressure for at least 24 hours.

2. Feed and Discharge Piping: Test for leakage at 100 psig for at least one hour.

b. Electrical: All electrical shop tests and inspections shall comply with appropriate sections of ANSI, NEMA, and IEEE. Supplier shall perform shop tests and inspections including, but not limited to control system tests before shipment.

PART 3 EXECUTION

3.1 INSTALLATION

a. Install all equipment in accordance with manufacturer's recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.

b. Contractor shall furnish and install, at the locations shown on the Drawings, a packaged system including field instrumentation, control panel, wiring, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.

3.2 FIELD TEST AND INSPECTIONS

Functional Test: The equipment shall be inspected for proper installation and proper connection to the satisfaction of the NTR. Upon successful functional test, the filter press supplier shall issue a certificate of proper installation.

3.3 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

a. One (1) person-day for installation assistance, inspection, testing, and completion of manufacturer's certificate of proper installation.

b. One (1) person-day for post-startup site training of plant operations personnel. Training shall be scheduled to occur after sludge has been generated and is ready for processing. Training shall not commence until an accepted detailed lesson plan for each training activity has been approved by the NTR. Contractor shall schedule the training session with the NTR.

-- End of Section --

SECTION 11370

TOP-ENTERING MIXER
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install, complete, a low-speed top-entering mixer for the sludge decant tank (T-10-1).

1.2 EQUIPMENT NUMBER

- a. Sludge Decant Tank Mixer, M-9-1

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Top-entering mixer G

1.3.1.1 Top-Entering Mixer

Manufacturer's catalog information, descriptive literature, specifications, and identification of materials and construction. Make, model, weight, bending moment, torque, and horsepower. Performance data showing compliance with specification requirements.

1.3.2 SD-04, Drawings

- a. Mechanical and electrical drawings G

1.3.2.1 Mechanical and Electrical Drawings

Detailed mechanical and electrical drawings showing equipment fabrications and interface with other items. Include complete dimensional data, sizes, and locations of connections to other work, dead weight and operating thrust of mixer assembly. Show finishes, materials of construction, and hardware. Provide details of mixer mounting plate, bolt holes, bolt sizes, etc., to conform with the manufacturer's recommended structural members for mixer support. Provide power and control wiring diagrams including terminals and numbers.

1.3.3 SD-06, Instructions

- a. Manufacturer's instructions G
- b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of manufacturer's written installation procedures shall be furnished to the NTR prior to installation. Instructions shall include

erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for the mixer and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

- a. Design calculations G
- b. Manufacturer's Certificate of Proper Installation

1.3.4.1 Design Calculations

Provide mixer design calculations, including substantiation of motor horsepower selection, signed and sealed by a registered engineer.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Following approved field testing, the manufacturer shall provide the NTR with a Manufacturer's Certificate of Proper Installation, signed by a legal representative of the mixer manufacturing firm, stating the representative has visually observed the installation, and confirms the mixer is installed in accordance with manufacturer's written and recommended instructions.

1.3.5 SD-12, Field Test Reports

- a. Functional Testing

1.3.6 SD-19, Operation and Maintenance Manuals

- a. Mixer and accessories, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds to the satisfaction of the NTR. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.8 NAMEPLATES

The mixer and motor shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. Nameplate for electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. The nameplate shall bear the equipment identification number indicated in this Specification.

1.9 MANUFACTURER'S SERVICES

- a. The manufacturer shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's recommendations, and is ready for permanent operation.
 3. Performance testing support as specified hereinafter.

PART 2 PRODUCTS

2.1 GENERAL

Mixer shall be furnished complete with speed reducer, electric motor drive connected through a rigid coupling guard, baseplate, agitator shaft, and impellers.

2.2 LOW-SPEED TOP-ENTERING MIXER

2.2.1 Description

- a. Mixer shall include a heavy duty speed reducer, drive motor with coupling, and guard. Each mixer shall also include rigid shaft coupling, mixer shaft, impeller, and baseplate with a tank lip seal. Provide auxiliary lip seal for preventing vapor escape from mixer seal with tank.
- b. Mixer shall be equipped with horizontal motor mounting, "hollow quill" gearbox and right-angle type gear reducer. Motor shall be connected to the gear reducer by a suitable flexible coupling, and shall be supported from the mixer housing to form an integral unit.
- c. The mixer gear drives must be built in accordance with the current AGMA standards. Gearing shall be all helical or a combination of helical and spiral bevel gears. Worm gearing is unacceptable.
- d. The full load operating noise levels of the mixer shall meet current OSHA Occupational Noise Standards and shall not exceed 85 dBA at 3 feet from any part of the drive assembly.
- e. Each mixer shall operate without overloading, jamming, or excessive vibration during normal operation.
- f. Drive housing shall be constructed of cast iron or welded steel construction. Fabricated housings must be stress relieved before machining. Housing shall be of sufficient rigidity to prevent damaging misalignment when subjected to mixer assembly peak combined torsional, thrust, and bending forces.

2.2.2 Design Requirements

The mixer shall provide 100 percent of solids under the following conditions:

a. Typical mixture characteristics:

1. Specific Gravity: 1.3
2. Solids Content: 3 to 4 percent
3. pH: 6 to 8
4. Particle Size: 0.01 to 0.1 mm

b. Mixing Cycle: continuous

c. Tank Dimensions:

- | | |
|-------------------------------|--|
| Diameter: | 11.5 feet |
| Side Wall Height: | 12 feet |
| 30 Degree Cone Bottom Height: | 3.3 feet |
| Total Liquid Height: | 13.8 feet (when tank is filled to HIGH LEVEL setpoint) |

- d. Baffles: The tank will be equipped with 4 equally spaced vertical baffles welded to the straight side walls of the tank. Each baffle will be 11 inches wide.
- e. Range of Tank Operating Depth: 4.3 feet to 13.8 feet (from bottom of cone bottom)

- f. Installation Location: Indoors
- g. Minimum Agitator Shaft Diameter: 2.5 inches
- h. Minimum Impeller Diameter: 48 inches
- i. Minimum Impeller Speed: 68 rpm

2.2.3 Speed Reducers

- a. Mixer shall be furnished with a heavy-duty speed reducer of the right-angle type, with spiral bevel or helical gears, and combinations thereof, specifically designed for mixer service. The reducer manufacturer shall have at least 5 years' successful and satisfactory experience with the same reducer in mixer service.
- b. The speed reducer used for the mixer shall be suitable for direct connection through a flexible coupling to the electric motor drive. The speed reducer shall be capable of continuous operation in the specified service and shall have a minimum service factor of 1.50 based on motor nameplate horsepower as defined in AGMA Standard Practice 420.04.
- c. The thermal rating of the speed reducer must not be exceeded by the design load or proper cooling shall be provided.
- d. General maintenance including, but not limited to, motor changes, gear changes, replacement of all antifriction bearings (except the bearings supporting the output shaft), and the oil system maintenance shall not require removal of the speed reducer housing from its foundation. Speed reducer shall be provided with eyebolts and lifting lugs.
- e. The reducer shall include provisions to prevent leakage of oil down the output shaft. An oil dipstick or sight gauge shall be provided to assure proper oil levels.
- f. The speed reducer output shaft shall be of sufficient size to independently carry the weight of the impeller shaft and impellers and supported by means of a "hollow quill" arrangement such that shaft deflections caused by operating loads do not affect alignment of the antifriction bearings or cause misalignment of gearing during mixer operation. The output shaft and "hollow quill" bearings shall be separate and independent. The output shaft bearings shall be above and below the drive housing.

2.2.4 Bearings

- a. All shaft support bearings shall be the antifriction roller or ball bearing type. Output shafts shall be supported by tapered roller bearings. The output shaft antifriction bearings shall be designed for a rated B-10 life under rated mixer output of 100,000 hours. All other antifriction bearings at the speed reducer shall be designed for a rated life of 100,000 hours. Basis for computation shall be the manufacturer's published computational methods for determined rated bearing life for this application.
- b. Bearings located outside the reducer oil supply shall be grease-lubricated and shall be equipped with grease fittings and

seals. Other bearings and gears shall be lubricated by a constant flow of oil by splash lubrication, an oil slinger, or an oil pump.

- c. Bearings must be located above the mixer mounting surface.

2.2.5 Guards

All rotating parts above the mounting level must be provided with guards in accordance with OSHA standards.

2.2.6 Impeller Shaft

- a. The impeller shaft shall be Type 304 stainless steel. The shaft shall be designed for a safety factor of 4 based on the yield strength of the particular metal. It shall be of overhung design. Use of bottom steady bearings is not permitted. Shaft shall be free of surface imperfections and inclusions which might seriously affect the fatigue strength of the shaft and its corrosion resistance. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy must be such so as to give a maximum runout at the lower end of the shaft of 1/8 inch for every 10 feet of overhang, as measured when turning over by hand.
- b. Shaft keyways will be so designed as to allow the turbines to be moved up or down the design setting a minimum of 6 inches. Shaft supporting the impellers shall be removable from speed reducer without disturbing the internal gearing of the speed reducer.
- c. Lower mixer shaft shall be connected to output shaft with rigid, stainless steel flanged coupling. Weld shall be full penetration, lended and stress relieved. Hub shall be interference-fit with key and taper pin connection. Mating coupling surfaces shall be machined to provide accurate alignment and the coupling halves registered to assure concentricity.
- d. The shaft design shall limit operating speed to a maximum of 65 percent of first lateral harmonic vibration frequency (critical speed) without the use of stabilizing devices or guide. The critical speed and torsional and bending stress calculations shall include the mass and moment of inertia of the impeller and couplings.
- e. Mixer shall include three segments, an output shaft and a lower shaft (consisting of two sections). The lower mixer shafts shall be provided in two sections to facilitate installation and maintenance of the mixer. The output and lower shaft sections shall be joined by couplings constructed of the same materials as the shaft. The mixer supplier shall size the shaft sections so that they may be removed vertically from tank through a manway located on the top of the tank with a minimum of one foot clearance with the building interior ceiling.

2.2.7 Impellers

- a. Provide two Type 304 stainless steel impeller. Impellers shall be designed and operated at a speed which does not require dynamic balancing. The impellers shall be of each manufacturer's design as necessary to meet the mixing requirements. The impellers shall be removable and shall have manufacturer's standard shaft

attachment.

- b. Impellers shall be of bolted construction and shall be connected to the agitator shaft with a hook key. The mixer shall have two impellers; one located at the tank's lower tangent line, and the other at mid-liquid depth.
- c. The impeller shall disassemble into components that can easily pass through a standard 2 foot diameter tank manway. It shall be possible to reassemble the impeller and attach it to the shaft once inside the tank.

2.2.8 Mounting

- a. Mounting height shall be per manufacturer's recommendation. Provide a minimum of 1 foot clearance between the impeller tips and the top of the cone bottom.
- b. Manufacturer shall provide details of mounting hardware such as baseplate dimensions.

2.2.9 Drives

- a. The connection between the motor output shaft and the reducer input shaft shall be made by a torsionally resilient flexible coupling, to reduce the effects of vibration and misalignment. The flexible coupling shall have all metallic power transmission elements.
- b. Direct coupled motors and vertically mounted motors will not be acceptable.
- c. Drive housings shall be constructed of high quality close-grained cast iron construction or reinforced structural steel (minimum 1/4-inch thick) with lifting lugs or holes. Housing shall be of sufficient rigidity to prevent damaging misalignment when subjected to mixer assembly peak combined torsional, thrust, and bending forces.
- d. The AGMA calculated drive hp rating shall be stamped on drive nameplate.

2.2.10 Drive Motors

- a. Motor shall conform to the applicable portion of Section BASIC ELECTRICAL MATERIALS AND METHODS.
- b. Motor shall be maximum 7.5 hp, suitable for 460-volt, 3-phase, 60Hz electrical service, with a maximum speed of 1,800 rpm. Enclosure type shall be TEFC. Motor shall be rated for constant torque.

2.3 SPARE PARTS AND SPECIAL TOOLS

- a. One complete set of seals, O-rings, retaining rings, and packing shall be furnished with the mixer unit.
- b. All spare parts shall be interchangeable with and of the same materials and workmanship as the corresponding original parts of

the mixer furnished under these Specifications.

- c. Manufacturer shall furnish one set of any special wrenches and tools which may be required for assembly, disassembly, or adjustment of mixer drives, shafts, and impellers.

PART 3 EXECUTION

3.1 PAINTING, ASSEMBLY, AND DELIVERY

- a. The equipment shall be prepared and painted with the manufacturer's standard corrosion resistant coating for the intended service.
- b. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.
- c. All exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventative compound.

3.2 INSTALLATION

Install all equipment in accordance with manufacturers' recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.

3.3 TESTING

- a. Shop Test: Each reducer and motor shall be shop-tested prior to shipment from the manufacturer's factory.
- b. Functional Testing: The manufacturer's representative shall assist with the initial test which shall include, but not be limited to, checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. Initial equipment and system adjustment and calibrations shall be performed in the presence of , and with the assistance of the manufacturer's representative.

3.4 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for installation assistance, and completion of Manufacturer's Certificate of Proper Installation.
- b. One (1) person-day for pre-startup or post-startup site training of plant operations personnel. Training shall include proper operation, maintenance, and assembly/disassembly techniques. The training schedule shall be approved by the NTR.

-- End of Section --

SECTION 11371

INSTRUMENT AIR SYSTEM

03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a compressed air system, complete. The compressed air system includes, but is not limited to, two reciprocating air compressors, air/oil separators, after coolers, and moisture separators, and one receiver tank, prefilter, dessicant dryer, and afterfilter, instrumentation, and local control panels.

1.2 EQUIPMENT NUMBERS

- a. Air Compressors: P-10-1-1, P-10-1-2
- b. Receiver Tank: T-10-1

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Air compressor and accessories G
- b. Receiver tank G
- c. Alternator panel and pressure controls G
- d. Valves
- e. Drain traps
- f. Intake filters
- g. Silencer
- h. Compressor motors G
- i. Dessicant dryer G

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G
- c. Electrical details G
- d. Instrumentation details G

1.3.2.1 Layout Drawings

Detailed mechanical drawings showing the make and model of each item, including ratings, capacities, and catalog cuts. Layout drawings showing proposed equipment layouts and interconnections.

1.3.2.2 Wiring Diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.2.3 Electrical Details

Electrical details including compressor motor details and electrical wiring diagrams.

1.3.2.4 Instrumentation Details

Instrumentation details including pressure gauges, pressure regulators, pressure switches, and local control panels.

1.3.3 SD-06, Instructions

- a. Manufacturer's instructions G
- b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the air compressor system installation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for the air compressor and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

- a. Design calculations G
- b. Manufacturer's Certificate of Proper Installation

1.3.4.1 Design Calculations

Design calculations for sizing of the air compressor, signed and sealed by a registered engineer. Include flow and pressure demand calculations.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Installation certificate, signed by a factory authorized representative of the air compressor system manufacturing firm, stating the representative has visually observed the installation, and confirms the air compressors and accessories are installed in accordance with manufacturer's written and

recommended instructions.

1.3.5 SD-12, Field Test Reports

a. Field Testing

1.3.6 SD-19, Operation and Maintenance Manuals

- a. Air compressor system and control panels, receiver tank, and desiccant dryer, data package 4. G

1.4 NOISE DATA

- a. The sound pressure level produced by the equipment provided hereunder shall not exceed an unloaded sound power level of 85 dbA, reference 20 micro-newtons per square meter, at a distance of 3 feet-free field.
- b. Noise data need not be supplied if the equipment manufacturer guarantees, in writing, that the sound pressure level at five (5) feet from any equipment or motor surface, with the equipment operating as specified, shall not exceed 95 dbA when measured with a sound level meter meeting the Type II requirements of ANSI Standard S1.4.
- c. If the sound pressure level of 95 dbA cannot be guaranteed, the manufacturer shall provide:
1. Sound power levels in decibels (re. watts x 10 to the -12 power) in octave band center frequencies for the compressor and motor combination when operating as specified.
 2. Frequency and sound power (or pressure) level of any audible discrete tones.
 3. Information on any design restrictions such as, but not limited to, ventilation requirements for totally enclosed equipment and relocating local controls remotely.
 4. A certified report of the noise level tests for the drive motors shall be submitted to the NTR prior to shipment.

1.5 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.6 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.7 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.8 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.9 MANUFACTURER'S SERVICES

- a. The manufacturer of the air compressor system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite installation assistance, inspection, and certification of installation, ensuring all equipment is installed in accordance with the manufacturer's recommendations and written instructions; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Functional and performance testing.
 3. Pre-startup classroom or jobsite training.

PART 2 PRODUCTS

2.1 AIR COMPRESSOR SYSTEM

Provide reciprocating air compressor system as a package system. The air compressor system consists of two reciprocating air compressors, receiver tank and instrumentation, after cooler, filters, desiccant dryer, and two local control panels.

2.2 PACKAGE DESCRIPTION

Number of compressors:	2
Capacity, each unit:	75 SCFM
Operating discharge pressure:	110 psig
Horsepower, each unit	20 HP
Configuration:	Base mounted
Receiver:	Vertical, 600-gallon (1 only)
After cooler:	Yes (one for each compressor)
Desiccant dryer:	Yes (1 only)

Oil removal filters: Yes

The capacity, operating discharge pressure, and horsepower listed in this specification are estimates based upon preliminary design information. Contractor shall be fully responsible for determining final air flow and pressure requirements, and use this information to size the compressor and motors.

2.3 COMPRESSOR

- a. Air compressors shall be two-stage, cast iron, oil-lubricated, air-cooled, reciprocating type with base mounted motor and V-belt drive with guard, including a convenient means for belt tensioning. Provide oil filter, air/oil separator, combination air intake filter silencer, and discharge cushion chamber. Compressors shall be equipped for automatic unloading during startup. Compressors shall be capable of continuous operation at 100 degrees F at specified output without overheating. Each compressor shall be independently base-mounted at the locations shown on the Drawings.
- b. Oil filter: Full flow type with replaceable elements capable of at least 1,000 hours of operation between changes.
- c. Air/Oil separator assembly: Rated at 150 psig and equipped with an ASME safety valve set at 150 psig. Air leaving air/oil separator shall contain no more than 2 ppm of oil.
- d. Intake filter: Dry type.
- e. Equip each compressor with full-discharge size flexible discharge connection, air check valve, isolation valve, and an adequate number of vibration isolators.

2.4 AFTERCOOLER

Provide an air-cooled aftercooler for each compressor, suitable for 150 psig working pressure, installed in the compressor discharge line. The aftercooler shall have capacity sufficient to cool the rated compressor capacity to within 20 degrees F of the ambient air temperature. The aftercooler assembly shall include a moisture separator with automatically trapped drain to be mounted downstream of the aftercooler. The body and cap of the separator shall be cast iron; the valve and seat shall be hardened chrome steel.

2.5 DRIVE MOTORS

Motors shall be squirrel-cage type, designed, manufactured, and tested in accordance with NEMA MG 1. The motors shall have drip-proof enclosures. Motors shall be rated continuous duty, compatible with the horsepower required by the driven equipment, 1,800 rpm maximum, 480 VAC, 60 Hz, 3-phase. The connected load shall not exceed the motor nameplate horsepower rating for operation under the most severe condition such as at a full relieving condition. Motors shall have a 1.15 service factor.

2.6 CONTROLS

2.6.1 Panels

Provide P-10-1-1 and P-10-1-2 with aluminum enclosures for local control panels LCP-10-1 and LCP-10-2, rated NEMA 12 and mounted in the compressor package. Control panels shall be provided in accordance with Section 13390, "Package Control Systems." Motor starters shall be contained in the local control panels.

2.6.2 Operator Controls and Indications

Provide the following control devices and indicators on the front of each control panel:

- a. Microprocessor based controller that shall include the following functions:
 1. Fully programmable.
 2. Full text/digital LED display.
 3. Full electrical system diagnostics.
 4. Mode selection that shall include:
 - Constant run.
 - Low demand.
 - Auto start/timed stop.
 - Stop.
 5. LED display shall include indication for:
 - RUN time.
 - Discharge air temperature.
 - System pressure.
 - Oil reservoir pressure.
 - Oil reservoir temperature.
 - Separation differential temperature.
 6. LED advisory lamps shall include:
 - Service air filter.
 - Change separator.
 - Change oil filter.
 - Change oil.
 - Low ambient/high temperature.
- b. Compressor ON light.
- c. Compressor AUTO light.
- d. POWER ON light.
- e. COMPRESSOR FAIL light.
- f. HAND/OFF/AUTO selector switch.
- g. START/STOP pushbuttons.
- h. RESET pushbutton.

2.6.3 Functional Requirements

- a. The following functional requirements are described for compressor P-10-1-1. Similar systems shall be provided for compressor P-10-1-2.
- b. Provide HAND/OFF/AUTOMATIC control at panel LCP-10-1. When in HAND mode, compressor shall start and stop by the use of START/STOP pushbuttons at panel LCP-10-1. When in AUTO mode,

compressor shall be controlled by automatic start/timed stop capacity control. When in OFF mode, compressor shall not start.

- c. Compressor shall maintain constant discharge pressure with inlet air modulating valve. Compressor discharge rate shall modulate from 40 to 100 percent of compressor rated capacity. Provide automatic start/timed stop capacity control. Compressor shall start automatically upon low pressure with modulating capacity control and stop automatically after an adjustable timed delay based on high pressure.
- d. Compressor and accessory equipment shall shut down if any one of the following conditions occur:
 - 1. HIGH TEMPERATURE of discharge air
 - 2. HIGH PRESSURE of discharge air
 - 3. Low oil pressure
 - 4. Fan motor overload
 - 5. Main motor overload
 - 6. Change separator
 - 7. Power interruption protection
 - 8. Electronic modulation control
- e. Provide a FAIL indication at each panel and a dry contact closure output to indicate FAIL when any of the shutdown conditions occur. The FAIL signal and any related alarm condition relays and indicators shall be maintained until manually reset by depressing the RESET pushbutton. FAIL signal shall be transmitted to Area Control Panel ACP-1.

2.6.4 DRY CONTACT CLOSURE

Provide a dry contact closure to transmit compressor IN SERVICE signal to Area Control Panel ACP-1 for both compressors.

2.6.5 External Interfaces

Provide the following discrete outputs for each compressor system at the control panel.

- a. Compressor ON status (each compressor).
- b. Compressor FAIL alarm.

2.6.6 Power Requirements

The power supply to each panel will be a single 480-volt, 3-phase, 60-Hz, 125 amp circuit run to the control panel.

2.6.7 Motor Starters

- a. Provide wye-delta or reduced voltage auto transformer type combination motor starters with thermal overloads for each drive motor and install in compressor control panels.
- b. Provide main Power Disconnect Switch for each panel.

2.7 ALTERNATOR PANEL ACCESSORIES

A surface mounted alternator panel shall be provided. Panel shall alternate the two compressors between a "lead" and "lag" mode. A selector switch shall be provided and shall have the selections "Compressor A - Compressor B - Alternate." Interlocks shall be provided so that only one compressor shall operate at a time.

2.7.1 Air Receiver (T-10-1)

- a. Vertical welded steel ASME labeled receiver.
- b. Maximum Working Pressure: 175 psig.
- c. Diameter: 4 feet 6 inches.
- d. Height: As required.
- e. Capacity: 600 gallons.
- f. Construction: Welded carbon steel plate with ASME code required inspection openings.
- g. Plate Thickness: As required for a maximum allowable working pressure of 175 psig plus a 1/16-inch corrosion allowance and not less than 1/4 inch.
- h. Design, construct, and stamp in accordance with the ASME Code for Unfired Pressure Vessels.
- i. Manufacturer's standard saddles.
- j. Painting: 1 coat, 2 MDFT rust-inhibitive primer; 2 coats, 4 MDFT alkyd enamel

2.7.2 Pressure Relief Valve

- a. Construction: Bronze body, bronze base, disc with steel spring, top outlet and malleable lifting lever.
- b. Meet the requirements of ASME Code for Unfired Pressure Vessels.
- c. Set to relieve at 150 psig and relieve full capacity of 100 scfm at 10 percent over pressure.

2.7.3 Flexible Discharge Connection

Provide flexible discharge connections.

2.7.4 Pressure Gauge and Pressure Switches

Provide a pressure gauge, and LOW PRESSURE, HIGH PRESSURE, and HIGH-HIGH PRESSURE switches with field adjustable setpoints. Pressure switch signals shall be sent to the Area Control Panel ACP-1. LOW PRESSURE switch shall have a setting range of 0 to 50 psig. HIGH PRESSURE switch shall be set at 120 psig. HIGH-HIGH PRESSURE switch shall be set at 135 psig.

2.8 REGENERATIVE DESICCANT AIR DRYER

2.8.1 Air Dryer

- a. Dual drying chambers and control system, complete, skid mounted.
- b. Rated Outlet Flow: 100 scfm at 150 psig.
- c. Pressure Dew Point: -40 degrees F with 100 degrees F inlet air and 100 degrees F ambient air temperature.
- d. Maximum Working Pressure: 150 psig.
- e. Provide two ASME code rated chambers utilizing a heaterless regeneration design.
- f. Fill chambers with activated alumina desiccant on stainless steel supports to help prevent channeling of the air.
- g. Provide drain and fill ports for each chamber without piping disconnects.

2.8.2 Dryer Interconnecting Piping

- a. Provide check valve in each chamber discharge line and a four-way switching valve in inlet air piping.
- b. Install required purge air piping for adequate chamber drying.
- c. Equip purge discharge line with purge air muffler.
- d. Equip purge air supply line with flow regulating device, factory adjusted and locked in position.
- e. Supply purge air from discharge side of the dryer and provide with air filter upstream of control connections.
- f. Pipe purge air to flow through the chamber countercurrent to the process air.
- g. Equip each chamber with ASME code rated safety relief valve and pressure gauge.
- h. Ship dryer preassembled with interconnecting piping installed, complete.

2.8.3 Dryer Control System

- a. Automatically alternate chambers for regeneration to provide an uninterrupted air supply without downstream pressure fluctuations.
- b. Equalize pressures in both desiccant chambers prior to changeover.
- c. Regenerate chambers in response to desiccant relative humidity control.

2.8.4 Switching Valve

- a. Provide to change a chamber from drying mode to regeneration mode.
- b. Type: Four-way, totally-enclosed, pneumatic cylinder-operated, nonlubricated and equipped with Teflon sealing surfaces.

- c. Control switching valve with four-way solenoid valve to direct dry air to air cylinder on the control valve.
- d. Electrical Power Supply to Control System: 120-volt, single-phase.

2.9 FILTERS AND ACCESSORIES

2.9.1 Coalescing Prefilters

- a. Provide to protect desiccant bed from oil or free water contamination in compressed air supply.
- b. Capable of removing 100 percent of all aerosols 0.75 micron and larger, and 100 percent of 0.3 micron solid particles.
- c. Include solenoid drain valve.

2.9.2 Particulate Afterfilters

- a. Provide to protect air lines from desiccant dust fines carried over from desiccant towers.
- b. Capable of removing 100 percent of 1 micron and larger particles.
- c. Include solenoid drain valve.

2.9.3 Solenoid Drain Valve

- a. Operation: 120-volt, Fail Close.
- b. Working Pressure: 150 psig.

2.10 ACCESSORIES

2.10.1 Anchor Bolts

Stainless steel bolts at least 1/2 inch in diameter or as shown.

2.10.2 Identification Plates

16-gauge stainless steel plates, mounted in readily visible locations on each separate component of equipment. Die-stamp equipment identification number on each plate, as listed herein or as shown, with 1/4-inch characters.

2.10.3 Lifting Lugs

Provided on equipment and equipment components over 100 pounds.

2.10.4 Piping

Equip compressors with full-size flexible discharge connection.

2.11 SPARE PARTS AND SPECIAL TOOLS

- a. Furnish, tag, and box for shipment and storage the following spare parts and special tools:
 - 1. Routine maintenance kit for 3,000 hours of operations

including oil separator: 1 set for each compressor.

2. Prefilter Replaceable Elements: 6 for each filter size.

3. After Filter Replaceable Elements: 6 for each filter size.

4. Special Tools: 1 set.

b. Provide an itemized list of the items provided.

2.12 PAINTING

a. Equipment and accessories specified herein with exception of the Air Receiver shall be factory prepared, primed, and finished with the manufacturer's standard coating system(s) suitable for this environment. Finish color shall be selected by the NTR.

b. The Air Receiver shall be painted as required earlier in this Section.

2.13 FACTORY TESTING

All equipment shall be factory tested for compliance with the operational requirements specified herein, and a certification of the test results of these tests shall be submitted to the NTR at equipment delivery to the jobsite.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

a. Install all equipment in accordance with manufacturers' recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.

b. Contractor shall furnish and install a packaged system including field instrumentation, control panel, motors, wiring, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.

c. The equipment shall be installed on vibration isolators in conformance with the manufacturer's suggested method. Contractor shall furnish such additional incidental materials and labor as required for complete and proper installations.

d. Install air compressor piping in accordance with the manufacturer's piping diagrams. Drains from the moisture separators, receiving tank, prefilter, and afterfilter shall be piped to the building floor trench.

3.2 TESTING OF INSTALLED EQUIPMENT

Prior to startup, all equipment shall be inspected for proper alignment, noisy operation, proper connection, and satisfactory performance, and any

deficiencies shall be corrected to the satisfaction of the NTR.

3.3 CONTROL SYSTEM ACCEPTANCE TESTS

- a. Field test the control system in order to meet the scheduling requirements. Conduct functional acceptance tests (FAT). The objective of these tests are to demonstrate that the control system is operating and complying with the specified performance requirements.
- b. Perform witnessed FATs on the complete control system for each compressor. Demonstrate each function to the satisfaction of the NTR on a paragraph-by-paragraph basis.
- c. Each test shall be witnessed and signed off by both the NTR and the ROIC.
- d. For each test description include the following minimum information:
 1. Specification page and paragraph of function demonstrated.
 2. Description of function and test to demonstrate it.
 3. Space for sign off and date by the NTR and ROIC.
- e. Notify the NTR at least four weeks prior to the date of the FATs.

3.4 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for installation assistance, certification of installation, initial checks, adjustments, calibrations, and procedures necessary to complete startup.
- b. One (1) person-day for pre-startup site training of plant operations personnel in the safe and proper operation and maintenance of the equipment. Training shall not commence until an accepted detailed lesson plan for each training activity has been approved by the NTR. Training shall be at such times as requested by the contractor and approved by the NTR.

-- End of Section --

SECTION 11380

DEWATERING AID FEED SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install, complete, a dewatering aid feed system which consists of, but is not limited to, a mix tank, portable mixer, air diaphragm pump, and accessories. This system will be used to mix a dry bulking agent such as perlite or diatomaceous earth, or a dry polymer with utility water, and to transfer the solution to either the sludge decant tank as a settling/dewatering aid, or the filter press for use as a precoat agent.

1.2 EQUIPMENT NUMBERS

- a. Dewatering Aid Mix Tank, T-9-1
- b. Dewatering Aid Mixer, M-9-2
- c. Transfer Pump, P-9-1

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Mix tank, mixer, and transfer pump G

1.3.1.1 Manufacturer's Catalog Data

Include manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction. Include performance data showing compliance with specification requirements. Include pump curves showing head, pressure, and capacity over the entire operating range.

1.3.2 SD-04, Drawings

- a. Layout drawings G

1.3.2.1 Layout Drawings

Detailed mechanical and electrical drawings showing equipment make, model, weight, fabrications, and dimensions, equipment and piping layouts, coupling locations, and interfaces with other items. Show mounting requirements. Include valving, piping, and fittings. Include catalog information on pulsation dampener, solenoid valve, and float switch.

1.3.3 SD-06, Instructions

- a. Manufacturer's instructions for air diaphragm pump and portable

mixer G

b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the equipment installation procedures shall be furnished to the NTR prior to installation. Instructions shall include erection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools for all equipment components, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-12, Field Test Reports

a. Field Testing

1.3.5 SD-19, Operation and Maintenance Manuals

a. Provide O&M manuals for the mixer and air diaphragm pump, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the Navy's Technical Representative (NTR), reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Materials shall be protected to the satisfaction of the NTR. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.4 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

PART 2 PRODUCTS

2.1 DEWATERING AID MIX TANK

- a. Provide one open-top, flat bottom tank for mixing dewatering aid and utility water. Tank capacity shall be 500 gallons. Tank shall be self-supporting and shall be constructed of linear polyethylene rated for operating temperatures up to 140 degrees F. Tank diameter shall be 5 feet, and tank height shall be 5 feet maximum.
- b. Provide a heavy duty mixer stand constructed of structural steel and coated with manufacturer's corrosion resistant coating. Mixer stand shall be anchored to the building floor slab. Stand shall allow easy adjustment of the mixer angle.
- c. Provide one 1-inch nozzle in the side of the tank consisting of a PVC screw-on bulkhead fitting with Viton gasket, suitable for connecting PVC dewatering aid transfer piping. Nozzle centerline shall be located 2 inches from bottom of tank.

2.2 DEWATERING AID MIXER

2.2.1 Design Requirements

- a. Provide a portable mixer which shall provide 100 percent suspension of solids under the following conditions:
 1. Mixture specific gravity: 1.3 to 1.4
 2. Total suspended solids: 25% of solution
 3. Viscosity: less than 1,000 cps
 4. pH: 6 to 8
 5. Particle Size: 0.001 to 0.1 mm
- b. Tank Dimensions: Tank dimensions are as described in paragraph 2.1.
- c. Range of Tank Operating Depth: 0 to 5 feet.
- d. Installation Location: Indoors.

2.2.2 Design Data

- a. Minimum Agitator Shaft Diameter: 0.75 inches
- b. Shaft Length: 48 inches
- c. Minimum Impeller Diameter: 10 inches
- d. Maximum Impeller Speed: 350 rpm

2.2.3 Bearings and Shaft Attachment

Mixer shall be furnished with a double-shielded, heavy duty lower drop bearing located below the shaft attachment to reduce shaft deflection. Shaft attachment shall be accomplished by means of a precision quill and drive bolt assembly.

2.2.4 Shaft

- a. Agitator shaft shall be constructed of Type 316 stainless steel.
- b. Agitator shaft shall not exceed 70 percent of first lateral and/or a minimum of 30 percent above second lateral critical speed.

2.2.5 Impeller

- a. The mixer shall be provided with one Type 316 stainless steel impeller. The impeller shall be removable and shall have manufacturer's standard shaft attachment.

2.2.6 Mounting

Mixer shall be clamp-mounted. Mounting angle shall be adjustable.

2.2.7 Speed Reducer

- a. Mixer shall be provided with a gear drive in accordance with current AGMA standards. Drive housing shall be cast aluminum. Gearing shall be alloy steel, all helical, permanently grease lubricated. No aluminum or fiber gears are acceptable. Drive shall have a minimum AGMA service factor of 1.5 based on motor nameplate horsepower.
- b. The AGMA calculated drive horsepower shall be stamped on the drive nameplate.

2.2.8 Drive Motor

- a. Motor shall conform to the applicable portion of Section 16050, "Basic Electrical Materials and Methods."
- b. Motor shall be 1/3 hp, suitable for 115 volt, single-phase, 60Hz electrical service, with a maximum speed of 1,800 rpm. Enclosure type shall be TEFC. Motor shall be rated for constant torque.

2.2.9 Spare Parts and Special Tools

- a. One complete set of seals, O-rings, retaining rings, and packing shall be furnished with the mixer unit.
- b. All spare parts shall be interchangeable with and of the same materials and workmanship as the corresponding original parts of the mixer furnished under these Specifications.
- c. Manufacturer shall furnish one set of any special wrenches and tools which may be required for assembly, disassembly, or adjustment of mixer drives, shafts, and impellers.

2.3 TRANSFER PUMP

Transfer pump shall be of the same manufacturer as the Filter Press Feed Pump specified in Section 11360, "Sludge Dewatering System."

2.3.1 Design Requirements

- a. Furnish one (1) air-operated, double-diaphragm type filter press feed pump with all ancillaries needed to efficiently transfer dewatering aid solution. Pump shall be capable of pumping a minimum of 45 gpm at 15 psig.
- b. Pump shall consist of a pump body with cover and base tee, diaphragm with compression spring assist on suction fill cycle, inlet and outlet ball valve-type checks, extra heavy duty air discharge muffler/silencer, air pressure regulator, air-lubricating filter, and plugged gauge cocks. Air consumption discharge shall be piped and vented to the building exterior.
- c. Pump shall be capable of starting and stopping at least 20 times per minute without subsequent damage to the pump or associated equipment, and shall be capable of running dry without damage to wearing parts. Pump shall be self-priming.
- d. Pump Body:
 1. Pump body, including covers, base tees, and spools, shall be cast iron. Wetted portions of the pump housing subject to the process fluid shall be aluminum.
 2. The entire assembly shall be capable of sustaining the vacuum and pressure loads imposed by the operating conditions described. Pump covers shall be provided with drilled and tapped holes for pressure air connections.
- e. Diaphragms shall be Buna-N or Geolast abrasive-resistant, and shall serve as a gasket between the bodies and covers.
- f. Check valves and seats shall be Buna-N or Geolast. Seats shall be replaceable.
- g. Provide one surge suppressor on the pump discharge, sized by the manufacturer for the operating conditions described herein. Suppressor shall have polypropylene body with Buna-N elastomers and shall have a flanged connection suitable for mounting to a tee.
- h. Provide a pressure gauge with pressure dampener on the pump discharge, and on the pump air supply line, with an indicator range of 0 to 100 psig. Pressure gauges shall be in accordance with Section 13000, "Instrumentation Components."
- i. Air Set: Provide a pressure regulator, solenoid valve, and needle valve on the pump air supply line for regulating air supply pressure to the pump.

2.3.2 Spare Parts and Special Tools

Two spare diaphragms, two spare check valve balls, two complete sets of valve seats, one spring assembly, and any special tools required to

dismantle the pump.

2.4 LEVEL CONTROL SYSTEM

- a. Provide a semi-automatic level control system for tank filling operations. Components of the level control system include a float-type level control switch, an electrically actuated solenoid valve, and hand switch. The float-type level control switch and hand switch shall be provided in accordance with Section 13390, "Package Control Systems". The electrically actuated solenoid valve shall be provided in accordance with Section 15100, "Valves and Operators."
- b. The level control system shall be an operator-initiated semi-automatic system. At the beginning of tank filling operations, the operator shall switch a local hand switch located near the tank. The hand switch shall automatically open a solenoid valve located on the utility water supply piping, and the mix tank will be filled with utility water. The float switch located in the mix tank shall have a HIGH LEVEL setpoint. The float switch shall be interlocked to the hand switch and the solenoid valve such that, at the HIGH LEVEL setpoint, a signal will be sent to the solenoid valve, automatically closing the valve.

2.5 ACCESSORIES

- a. Equipment weighing over 100 pounds shall be provided with lifting lugs.
- b. Provide all baseplates required to fasten equipment to a steel support frame.

PART 3 EXECUTION

3.1 INSTALLATION

Install all equipment in accordance with manufacturer's recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.

3.2 FIELD TEST AND INSPECTIONS

Functional Test: The equipment shall be inspected and tested for proper installation and operation to the satisfaction of the NTR.

-- End of Section --

SECTION 11390

VERTICAL SUMP PUMP SYSTEM
03/97

PART 1 GENERAL

1.1 WORK INCLUDED

- a. This section covers the work necessary to furnish and install the vertical sump pump system, complete. The concrete sump and cover are covered under Section 03300, "Cast-in-Place Concrete." The steel sump tank (T-12-1) is covered under Section 13200, "Vertical Steel Tanks."
- b. The vertical sump pump system includes, but is not limited to, two vertical centrifugal submersible pumps, two level switches to control the pumps, one high level alarm switch, two pressure indicators for the pump effluent, two ball check valves, two ball isolation valves, and a local control panel.

1.2 EQUIPMENT NUMBERS

- a. Vertical Submersible Pumps, P-12-1, P-12-2

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Vertical Submersible Pumps G
- b. Level Switches G
- c. Sump Pump Control Panel G

1.3.1.1 Vertical Sump Pumps

Catalog data should include the make, model, horsepower and motor nameplate data as defined by NEMA, materials of construction, specifications, and any descriptive literature about the pumps and motors. Also provide performance data curves showing head, capacity, horsepower demand, rated horsepower, and pump efficiency over the entire operating range of the pump from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design point.

1.3.2 SD-04, Drawings

- a. Layout drawings G
- b. Wiring diagrams G
- c. Electrical details G

d. Instrumentation details G

1.3.2.1 Layout drawings

Detailed mechanical and electrical drawings showing equipment fabrications and dimensions, piping layouts, coupling locations, and interfaces with other items.

1.3.2.2 Wiring diagrams

Power and control wiring diagrams including terminals and numbers.

1.3.2.3 Electrical Details

Electrical details including submersible pump motor details and electrical wiring diagrams.

1.3.2.4 Instrumentation details

Instrumentation details including sump level control detail, pressure gauges, and local control panel.

1.3.3 SD-06, Instructions

a. Manufacturer's instructions G

b. Spare parts and special tools

1.3.3.1 Manufacturer's Instructions

Two (2) copies of the submersible pump installation procedures shall be furnished to the Navy's Technical Representative (NTR) prior to installation. Instructions shall include recommended piping connection and installation details, including fastening details. Failure to furnish these installation procedures may be cause for rejection of the equipment.

1.3.3.2 Spare Parts and Special Tools

List of recommended spare parts and special tools required for the submersible pumps and accessories, required to keep the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. List special tools, materials, and supplies furnished with the equipment for use prior to and during startup and for future maintenance.

1.3.4 SD-08, Statements

a. Design calculations G

b. Manufacturer's Certificate of Proper Installation

1.3.4.1 Design Calculations

Head loss calculations for pump sizing, signed and sealed by a registered engineer.

1.3.4.2 Manufacturer's Certificate of Proper Installation

Installation Certificate, signed by a factory authorized service

representative of the pump manufacturing firm, stating the representative has visually observed the pump installation, and confirms the submersible pump system is installed in accordance with manufacturer's written and recommended instructions.

1.3.5 SD-11, Factory Test Reports

- a. Factory test reports for pumps, level switches, and control panel.

1.3.6 SD-12, Field Test Reports

- a. Functional and performance test reports

1.3.7 SD-19, Operation and Maintenance Manuals

- a. Submersible pump system, including level switches and control panel, data package 4. G

1.4 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992. Equipment shall be supported by a service organization that is, in the opinion of the NTR, reasonably convenient to the jobsite. Equipment of the same types shall be the product of one manufacturer.

1.5 DELIVERY

During shipment all equipment shall be braced and protected from any distortion or damage; any such distortion or damage shall be the basis for rejection of the equipment. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.6 STORAGE AND HANDLING

Inspect equipment and materials delivered to the site for damage; unload and store with minimum handling. Store equipment and material on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage, to the satisfaction of the NTR, to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.

1.7 SAFETY REQUIREMENTS

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded to the satisfaction of the NTR.

1.8 NAMEPLATES

The submersible pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each pump shall show the capacity in gpm at rated speed in

rpm and head in feet of water. Nameplate for each electric motor shall show at least the minimum information required by 10.38 NEMA MG 1. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.9 MANUFACTURER'S SERVICES

- a. The manufacturer of the submersible sump pump system shall provide an experienced and fully qualified field engineer for technical assistance during installation, startup, and testing. The cost of this technical assistance, including labor and expenses shall be borne by the contractor. The minimum amount of person-days to be provided are listed in SECTION 3. All system visits by the manufacturer's representative shall be coordinated with and approved by the NTR.
- b. Services shall include, but not be limited to:
 1. Onsite installation assistance and inspection to ensure that all equipment is installed in accordance with the manufacturer's recommendations; initial checks, adjustments, calibrations, and procedures necessary to complete system startup.
 2. Written certification from manufacturer, after all tests and adjustments are made, that the system is properly installed and functioning in accordance with these Specifications and the manufacturer's requirements and recommendations, and is ready for permanent operation.

PART 2 PRODUCTS

2.1 DETAIL SUMP PUMP SPECIFICATION

2.1.1 Service Conditions and Design Requirements

The sump pump system shall be designed for unattended operation in a steel sump tank that is 5 feet wide by 5 feet long by 5.5 feet deep. The sump tank will receive pressure filter drain down, decant water from the sludge storage tank, filtrate from the sludge press, washdown water, floor runoff, and condensate from the building heating system. The system shall automatically pump the sump contents to the treatment plant process influent line. The sump system shall be vapor tight to prevent the migration of vapors to the treatment building interior. This includes installing P-traps on influent piping to the sump to prevent vapor backup in the piping. The sump tank shall be vented to the atmosphere outside the treatment building using vent piping as shown on the Drawings.

2.1.2 Pump Equipment

Submersible Pumps (P-12-1, P-12-2): The submersible pump system shall consist of a duplex arrangement of two vertical submersible pumps with liquid level control and a local control panel. Pump materials of construction shall be cast iron. The impeller shall be 300 series stainless steel. The pumps shall be manifolded together above the sump tank cover. The pumps shall be mounted on a single cover directly on the sump tank, and the cover shall contain a penetration with a vapor tight seal for effluent piping from the pump. The pumps shall be provided with a lifting lug to remove the pumps from the sump tank if necessary for maintenance. The pumps shall be provided with double-mechanical seals.

The motors shall be oil-filled with built-in, overload protection. Furnish pumps with sufficient length of waterproof power cable to reach the local control panel (LCP-12).

2.1.3 Pump Characteristics

- a. The vertical sump pumps are sized based on the following conditions used in the preliminary hydraulic analysis. It shall be the responsibility of the contractor to confirm and provide a final pump size based on the piping and equipment arrangement of the final design.

Design Flow Rate:	30 Gal/Min (each pump)
Total Dynamic Head:	127 feet
Maximum Solids Diameter:	0.25 inches

- b. The submersible sump pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered.

2.1.4 Pump Drives

The vertical submersible sump pumps are estimated to require the following drive units. It shall be the contractor's responsibility to confirm the final drive size based on the head and flow characteristics of the pump. Associated changes in electrical facilities resulting from adjusted drive sizes shall be completed by the contractor.

Rated speed:	3,500 rpm
Rated horsepower:	5 hp (each)
Rated voltage:	480 VAC
Phase:	3-phase

2.1.5 Pump System Instrumentation

- a. Provide a pressure gauge with diaphragm seal, ball check valve, and isolation ball valve on the discharge from each pump. Pressure gauge shall be supplied in accordance with the requirements of Section 13000, "Instrumentation Components." Valves shall be provided in accordance with Section 15100, "Valves and Operators." Pressure gauges shall provide direct readings on a 4.5 inch dial for pressures ranging from 0 to 100 psig. The accuracy should be plus or minus 0.5 percent of span.
- b. Provide a 316 stainless steel float-type control switch that operates on a vertical float rod connected to an above-board switch for pump on/off control.
- c. Provide a sump water level HIGH level alarm.

2.1.6 Local Control Panel

Provide a local control panel (LCP-12) in accordance with Section 13390, "Package Control Systems," that includes level control for the sump, control of the pumps, alarm interlocks, relays, motor starters, OOA switches, main disconnect switch, and indicator lights. Control panel shall be rated NEMA 4.

2.1.7 Extra Materials

Furnish one complete set of any special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of the sump pump system. Special tools are considered to be those which, because of their limited use are not normally available, but are necessary for the particular equipment.

2.2 FUNCTIONAL DESCRIPTION

- a. The following functional descriptions describing the operations of the submersible sump system will be considered the essence of the specifications. Furnish and install all necessary equipment, instruments, modules and appurtenances to achieve the performance as hereinafter described, even though such items may not be included in any specific listing of equipment furnished.
- b. The electrical control system shall consist of a Local Control Panel (LCP-12) and external input devices to operate the submersible sump pump system automatically and protect equipment and the treatment process from fault conditions. The control panel shall be a NEMA 4 enclosure containing power and control devices suitable for operating the submersible pumps and level controls in accordance with the Drawings. Fabrication shall be performed by a UL approved shop experienced in the fabrication of industrial control panels. LCP-12 shall be provided in accordance with the requirements of Section 11390, "Package Control Systems."
- c. Power shall be three phase 480 volts. Devices (including motors) shall be sized accordingly. The panel shall contain external operated disconnect switches and overload reset button, branch fusing and motor control for both pumps. Motor starters shall contain IEC style overload relays for thermal overload protection, and contain a differential tripping mechanism for phase fault protection. Motor starters for the pumps shall be contained in LCP-12. Provide transformer for control circuitry. Provide electrical and mechanical alternators to alternate pump use and provide more predictable wear. Provide interlocks so that only one pump shall be allowed to operate at a time.
- d. Functional Requirements:
 1. Sump pumps shall be controlled by separate ON/OFF/AUTO selector switches on LCP-12. One effluent pump shall be allowed to operate at a time.
 2. Sump pump shall automatically pump the sump tank contents to the influent process line when the PUMP ON level is reached in the sump tank. Pump shall automatically shut down when the PUMP OFF level is reached in the sump tank. When activated, a HIGH HIGH level switch in the sump shall activate a visual alarm on LCP-12, indicating sump high high water level. The level settings shall be as follows:

HIGH HIGH level alarm setting:	2.5 feet below top of sump tank
PUMP ON Setting:	3.00 feet below top of sump tank
PUMP OFF Setting:	4.75 feet below top of sump tank
 3. Each pump will send a FAIL TO START/FAIL WHILE RUNNING signal to LCP-12, and a visual alarm on LCP-12 shall activate. In this

event, the out-of-service pump shall be automatically energized, pumping the sump contents until the PUMP OFF level is reached in the sump. Manual RESET will be required to reset the failed pump.

4. LCP-12 will send the following signals (normally open dry contact, close on signal) to the Area Control Panel ACP-1:

Sump HIGH HIGH level
Sump Pump P-11-1 FAULT
Sump Pump P-11-2 FAULT

e. Operator Interfaces: Furnish operator interfaces and indicating lights on LCP-12 as follows:

1. Sump HIGH HIGH level indicating light/alarm.
2. Pump FAIL TO START indicating lights (each pump).
3. Pump FAIL WHILE RUNNING indicating lights (each pump).
4. Pump ON/OFF/AUTO selector switches (each pump).
5. Pump ON indicating lights (each pump).
6. RESET pushbutton.
7. Main disconnect switch that can be locked out to de-energize the pumps during maintenance.

2.3 FACTORY TESTING

Pump shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Only one pump shall be tested, and the testing shall be used to determine the adequacy of the untested pump. Certified test results shall be submitted to the NTR. Include test data sheets and curve test results.

PART 3 EXECUTION

3.1 INSTALLATION

- a. Install all equipment in accordance with manufacturer's recommendations and printed instructions. Equipment installation shall not be allowed until the contractor furnishes the NTR with the installation instructions.
- b. Contractor shall furnish and install, at the location shown on the Drawings, a packaged system including field instrumentation, local control panel, motors, wiring, piping, fittings, valves, anchor bolts and fasteners, safety guards, painting, spare parts and other appurtenances, and furnish all labor, supervision, testing, training, materials, tools, and appliances.
- c. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Connect discharge piping without imposing strain to pump connections. Provide pipe supports as required so the piping weight is not being supported on the pump.

3.2 FUNCTIONAL TEST

Perform manufacturer's standard testing procedure on installed pumps.
Submit results to the NTR.

3.3 PERFORMANCE TEST

- a. Conduct a performance test on each pump. Perform the test under actual or approved simulated operating conditions. Conduct the test for a continuous three (3) hour period without system malfunction. If a malfunction occurs during testing, adjust the system and reconduct the test.
- b. Record the total head and capacity of each pump at twenty (20) minute intervals during the test. Submit the test results to the NTR.

3.4 CONTROL SYSTEM ACCEPTANCE TESTS

- a. Field test the control system in order to meet the scheduling requirements. Conduct functional acceptance tests (FAT). The objective of these tests are to demonstrate that the control system is operating and complying with the specified performance requirements.
- b. Perform witnessed FATs on the complete control system. Demonstrate each function to the satisfaction of the NTR on a paragraph-by-paragraph basis.
- c. Each test shall be witnessed and signed off by both the NTR and the ROIC.
- d. For each test description include the following minimum information:
 1. Specification page and paragraph of function demonstrated.
 2. Description of function and test to demonstrate it.
 3. Space for sign off and date by the NTR and ROIC.
- e. Notify the NTR at least two weeks prior to the date of the FATs.

3.5 CONTROL SYSTEM RESPONSIBILITY

- a. All components of the control system have been included in this Section so that the contractor will receive a completely coordinated and properly integrated system for efficiency, ease in operation and correct functional relationship among all elements of the system. Therefore, it is the intent of this Specification that the equipment specified under this Section will be furnished by a single Control System Supplier. This requires that the Control System Supplier be responsible for the satisfactory operation of the instrumentation and control system furnished hereunder.
- b. An acceptable Control System Supplier shall provide the following minimum materials and services:

1. Design, assemble, furnish, and supervise installation of major components of the control system.
2. Check final power and signal connections.
3. Adjust, tune, and calibrate system.
4. Examine and, if required, coordinate modification of existing signals, wiring, or connections from the Area Control Panel ACP-1 for compatibility into the control system.
5. Verify complete compatibility of existing wiring, signals, connections, with control system.
6. Provide the advice, diagnosis and/or repair of control system during the warranty period.

- c. Provide all materials and services listed immediately above at no additional cost.

3.6 MANUFACTURER'S SERVICES

Provide manufacturer's services for the minimum person-days listed below, travel time excluded.

- a. One (1) person-day for manufacturer's representative to observe and approve the completed installation, complete Manufacturer's Certificate of Proper Installation, and provide basic training of plant operations personnel.

-- End of Section --

SECTION 13000

INSTRUMENTATION COMPONENTS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

See Section 13402, "Process Instrumentation and Control Systems (PICS)."

1.2 SUBMITTALS

Submit the following as part of the work plan in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Flow Element and Transmitter, Electromagnetic FE/FIT- 2-1 G
- b. Flow Element and Indicator, Propeller FE/FI-3-1 G
- c. Flow Element, Impeller FE-1-2-Y (1 through 34), FE-8-1 G
- d. Flow Monitor/Totalizer Transmitter FIT-1-2-Y (1 through 34), FIT-8-1 G
- e. Flow Switch, Paddle FS-12-1 G
- f. Level Switch, Float Type with Integral Switch LSH-9-1, LSH-1-1-X (see paragraph 2.6 for values of X) G
- g. Level Element, Pressure Type Submersible LE 1-2-Y(Y=1 THRU 34), LE-1-3-Z (Z= 1GW12, 1GW39, 1GW9, 1GW34, 1GW35, 1GW36, 1GW37, 1GW4, 1GW14, 1GW30), LE-1-4-1 G
- h. Level Transmitter, Electronic LIT 1-2-Y(Y=1 THRU 34), LIT-1-3-Z (Z= 1GW12, 1GW39, 1GW9, 1GW35, 1GW36, 1GW37, 1GW4, 1GW14, 1GW30), LIT-1-4-1 G
- i. Level element and Transmitter, Ultrasonic LE/LIT-10-1 G
- j. Pressure Differential Transmitter, Electronic PE/PIT-8-1 G
- k. Pressure Gauge PI-1-2-Y (Y=1 THRU 34), PI-7, PI-9 G
- l. Pressure Transmitter, Electronic PE/PIT-2-1 G
- m. Pressure Seal, Diaphragm G
- n. Warning light, Strobe type G
- o. Horn G

p. Autodialer G

1.2.2 SD-04 Drawings

a. Wiring Diagrams G

b. Mounting details G

1.2.3 Operations and Maintenance Manuals

All instrumentation listed herein, data package 4.

1.3 DEFINITIONS

See Section 13402, "Process Instrumentation and Control Systems (PICS)," paragraph 1.3.

PART 2 PRODUCTS

2.1 FLOW ELEMENT AND TRANSMITTER, ELECTROMAGNETIC FE/FIT-2-1

1. General:
 - a. Function: Measure, indicate, and transmit the flow of a process liquid in a full pipe.
 - b. Type: Electromagnetic flowmeter, with operation based on Faraday's Law, utilizing the pulsed dc type coil excitation principle with high impedance electrodes.
 - c. Parts: Flow element, transmitter, interconnecting cables, mounting hardware, and calibrator.
2. Service:
 - a. Flow Stream Descriptions: Groundwater contaminated with trichloroethene and vinyl chloride with small abrasive media such as silt and gravel.
 - 1) Water: Water with slight alkalinity (7.5 to 8 pH) and up to 10 mg/l suspended solids.
3. Performance:
 - a. Flow Range: 0 to 240 gpm.
 - b. Accuracy: Plus or minus 1 percent of rate for all flows resulting from pipe velocities of 1 to 33 feet per second.
 - c. Turndown Ratio: Minimum of 10 to 1 when flow velocity at minimum flow is at least 1 foot per second.
4. Features:
 - a. Zero stability feature to eliminate the need to stop flow to check zero alignment.
 - b. No obstructions to flow.
 - c. Very low pressure loss.
5. Process Connection:
 - a. Meter Size: To match line size of pipe installed into.
 - b. Connection Type: 150-pound ANSI raised-face flanges or wafer style depending on meter size, unless otherwise noted.
 - c. Flange Material: Carbon steel, unless otherwise noted.
6. Signal Interface: 4 to 20 mA dc for load impedance 0 to 800 ohms minimum for 24V dc supply.
7. Power: 120V ac, 60-Hz, unless otherwise noted.
8. Element:
 - a. Meter Tube Material: 304 stainless steel, unless otherwise noted.
 - b. Liner Material: Teflon.

- c. Liner Protectors: Covers on each end to protect liner during shipment.
- d. Electrode Type: Flush or bullet nose as recommended by the manufacturer for the noted stream fluid.
- e. Electrode Material: 316 stainless steel, unless otherwise noted.
- f. Enclosure: NEMA 4, unless otherwise noted.
- g. Grounding Ring/Electrode Material: 316 stainless steel, unless otherwise noted.
- 9. Transmitter:
 - a. Display: Indicating and totalizing.
 - b. Mounting: Integral.
 - c. Enclosure: NEMA 4X.
 - d. Zero and Span: Field adjustable.
 - e. Indicator: Digital 16-character display, with scale range as noted.
 - f. Totalizer: Digital 16-character display with totalizer unit digit value.
- 10. Cables:
 - a. Types: As recommended by manufacturer.
 - b. Lengths: As required to accommodate device locations.
- 11. Calibration System:
 - a. Features:
 - 1) Field programmable electronics.
 - 2) Self-diagnostics with troubleshooting codes.
 - 3) Ability to program electronics with full scale flow, engineering units, meter size, zero flow cutoff, desired signal damping, totalizer unit digit value, etc.
 - 4) Initial flow tube calibration and subsequent calibration checks.
 - b. Equipment:
 - 1) Built-in electronics with each unit provided.
 - 2) Alternatively, one portable calibrator of each type required for the various electromagnetic flowmeters provided on the project.

2.2 FLOW ELEMENT AND INDICATOR, PROPELLER FE/FI-3-1

- 1. General:
 - a. Function: Measure flow rate of a process liquid.
 - b. Type: Flanged tube, propeller meter with magnetic coupled drive.
- 2. Service:
 - a. Fluid: Filtered wastewater.
 - b. Pressure: 150 psi standard, 250 psi when noted.
 - c. Temperature: 100 degrees F maximum.
 - d. Flow Direction: Uni-directional measurement.
- 3. Performance:
 - a. Accuracy: Plus or minus 2 percent of flow rate.
- 4. Element:
 - a. Materials:
 - 1) Cover Plate: Cast iron.
 - 2) Propeller: Molded polyethylene.
 - 3) Gearbox: Brass.
 - 4) Bearings: Stainless steel.
 - b. Mounting:
 - 1) Type: In-line tube.
 - 2) Materials: Carbon steel.
 - c. Line Size: As noted.

- d. Process Connections: AWWA 150-pound flanged end connections.
 - 5. Indicator:
 - a. Type: Gauge.
- 2.3 FLOW ELEMENT, IMPELLER FE-1-2-Y (1 THROUGH 34), FE-8-1
- 1. General:
 - a. Function: Measure flow rate of process liquid.
 - b. Type: Thread-mount, six blade impeller meter with non-magnetic sensor.
 - 2. Service:
 - a. Flow Stream Descriptions: Groundwater contaminated with trichloroethene and vinyl chloride with small abrasive media such as silt and gravel.
 - 1) Water: Water with slight alkalinity (7.5 to 8 pH) and up to 10 mg/l suspended solids.
 - b. Pressure: 400 psi maximum, standard.
 - c. Temperature: 105 degrees C maximum, standard.
 - d. Flow Direction: Single.
 - 3. Performance:
 - a. Range: 0 to 10 GPM for FE-1-2-Y and 0 to 300 GPM for FE-8-1.
 - b. Accuracy: Plus or minus 1.0 percent of full scale.
 - c. Repeatability: Plus or minus 0.5 percent of full scale.
 - d. Linearity: Plus or minus 1.0 percent of full scale.
 - 4. Element:
 - a. Materials:
 - 1) Body: Polvinylidene fluoride (PVDF).
 - 2) Impeller: PVDF.
 - 3) Shaft: Zirconia ceramic.
 - 4) O-Rings: Viton.
 - 5) Body Sleeve: 316 Stainless steel.
 - b. Mounting:
 - 1) Type: Adjustable penetration through weldolet or pipe saddle.
 - 2) Materials: 316 Stainless steel connector and adjustment hardware.
 - c. Line Size: 1/2 Inch for FE-1-2-Y, and 6 inch for FE-1-8-1.
 - d. Process Connection: To match line size of pipe.
 - e. Output:
 - 1) Signal: 0 to 200 Hz conditioned pulse.
 - 2) Transmission Distance: 2000 feet maximum.
 - 5. Classification: Suitable for Class 1, Division 2 environment.
 - 6. Cable: as required to reach transmitter.
 - 7. Provide with transmitter (see paragraph 2.4 for transmitter).

2.4 FLOW MONITOR/TOTALIZER TRANSMITTER FIT-1-2-Y (1 THROUGH 34), FIT-8-1, FI-3-1

- 1. General:
 - a. Function: Analyze flow, display rate and total and transmit flow rate of process liquid.
 - b. Type: Microprocessor based.
- 2. Service:
 - a. Operating Temperature Range: Minus 30 to plus 50 degrees C.
 - b. Relative Humidity: 0 to 100 percent, non-condensing.
- 3. Performance:
 - a. Sensitivity: 0.1 percent of span.
 - b. Stability: 0.1 percent of span per 24 hours, non-cumulative.
 - c. Repeatability: 0.1 percent of span.

- d. Non-linearity: 0.1 percent of span.
- 4. Monitor/Totalizer:
 - a. Features:
 - 1) Type: Microprocessor based flow computer.
 - 2) Relays: Two.
 - 3) Contact Outputs:
 - a) Setpoints: Each adjustable 0 to 100 percent of measured scale, unless otherwise noted.
 - b) Deadbands: Each adjustable 0 to 20 percent of measured scale span, unless otherwise noted.
 - c) Indicators: Each with LED light when relay energized.
 - 4) Rate Indicator:
 - a) Type: Seven-digit LCD.
 - b) Scale Range: As noted.
 - 5) Flow Totalizer Indicator:
 - a) Type: Seven-digit LCD, nonreset.
 - b) Unit Digit Value: As noted.
 - c) Special: Reverse flow will not decrement totalizer.
 - 6) Memory: RAM with backup battery provided.
 - 7) Enclosure:
 - a) Type: 1/2 DIN, NEMA 4X.
 - b) Material: Polycarbonate.
 - c) Mounting: Universal, unless otherwise noted.
 - 8) Signal Interface:
 - a) Input: 0 to 200 Hz conditioned pulse signal from flow element sensor, unless otherwise noted.
 - b) Output: Isolated 4 to 20 mA dc for maximum load of 625 ohms, unless otherwise noted.
 - c) Contacts: Two SPDT, U.L. rated 5A at 115/230 VAC or 3A at 30 VDC resistive.
 - 9) Power: 120 V ac, 60-Hz, unless otherwise noted.

2.5 FLOW SWITCH, PADDLE FS-12-1

- 1. General:
 - a. Function: Sense fluid flow in the pipeline and switch a set of contacts when the flow is positive (open contact on flow.)
 - b. Type: Paddle flow sensor with magnetically coupled switch.
 - c. Parts: Unitized assembly of paddle type flow sensor and switch.
- 2. Performance:
 - a. Maximum Temperature, Operating: 300 degrees F.
 - b. Maximum Pressure, Operating: 300 psi, unless otherwise noted.
- 3. Process Connections: 1-1/4-inch male NPT mounting collar mated to a 2-inch half-coupling with a 2-inch by 1-1/4-inch bushing.
- 4. Signal Interface:
 - a. Output: Single-pole, double-throw (SPDT) switch.
 - b. Contact: 120V ac, 5 amps resistive, continuous.
- 5. Enclosure:
 - a. Type: Standard, NEMA 4, unless otherwise noted.
 - b. Mounting: Integral with switch assembly.
- 6. Element:
 - a. Paddle:
 - 1) Size: Convertible paddle, trimmed to required length in field.
 - b. Wetted Parts: Stainless steel, unless otherwise noted.

2.6 LEVEL SWITCH, FLOAT TYPE WITH INTEGRAL SWITCH LSH-9-1, LSH-1-1-X (X = EV1/2/3/4/34, EV5/6/7/33, EV8/9/10/32, EV11/12/13/14/30/31, EV15/16/17/18/29, EV19/20/21/28, EV23/24/25/26/27)

1. General:
 - a. Function: Actuate contact at preset liquid level.
 - b. Type: Direct-acting float with an enclosed mercury switch and integral cable.
 2. Service:
 - a. Flow Stream Descriptions: Groundwater contaminated with trichloroethene and vinyl chloride with small abrasive media such as silt and gravel.
 - 1) Water: Water with slight alkalinity (7.5 to 8 pH) and up to 10 mg/l suspended solids.
 - b. Pressure: Atmospheric.
 - c. Temperature: 0 to 50 degrees C.
 3. Performance:
 - a. Set Point: LSH-9-1, 6 inches below top of tank; LSH-1-1-1 through LSH-1-1-5, 3 inches above finished floor.
 - b. Differential: 1-inch maximum.
 - c. Temperature: 0 to 120 degrees F (50 degrees C).
 4. Features:
 - a. Entire Assembly: Watertight and impact-resistant.
 - b. Cable: Combination support and signal; length as noted or as necessary per mounting requirements.
 - c. Materials:
 - 1) Float: Chemical resistant polypropylene or other corrosion resistant material suitable for use in sewage and sludge applications.
 - 2) Cable: Type STO No. 18-2, neoprene or PVC jacket, rated 600V.
 - 3) Clamps: PVC or Neoprene.
 - d. Mounting: Pipe (or) suspended as noted.
 - 1) Pipe: Corrosion-proof cable clamp for 1-inch pipe.
 - 2) Suspended: Necessary brackets and clamps for tank top or vessel; integral or attached weight assembly for stabilization and positive operation.
 5. Signal Interface:
 - a. Switch: SPST or DPST, arrangement as required per Drawings.
 - b. Contact: Rated 5A continuous at 120V ac.
- 2.7 LEVEL ELEMENT, PRESSURE TYPE SUBMERSIBLE LE 1-2-Y(Y=1 THRU 34), LE-1-3-Z (Z= 1GW12, 1GW39, 1GW9, 1GW34, 1GW35, 1GW36, 1GW37, 1GW4, 1GW14, 1GW30), LE-1-4-1

1. General:
 - a. Function: Measure and transmit a signal proportional to pressure or level.
 - b. Type: Totally submersible, two-wire transmitter.
 - c. Parts: Transmitter and cable.
2. Service:
 - a. Fluid: As noted.
3. Performance:
 - a. Range:
 - 1) LE 1-2-4: See Drawing C16.
 - 2) LE 1-3-2: 0 to 20 feet.
 - 3) LE 1-4-1: 0 to 20 feet.
 - b. Accuracy: 0.1 percent of full scale.
 - c. Sensitivity: Plus or minus 0.5 percent of reading.
 - d. Temperature, Operating: Minus 5 to plus 140 degrees F.
4. Features:
 - a. Dimensions: 0.69 inches diameter by 8.66 inches length.

- b. Materials: Titanium body.
 - 5. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 750 ohms minimum for 24V dc supply without load adjustment.
 - 6. Cable: Length as required to measure vessel level.
 - 7. Sensor Terminal Junction Box:
 - a. Enclosure Type: NEMA 4X
 - b. Terminal Strip: 7 DIN standard terminals accepting 24 AWG to 12 AWG wires.
 - c. Dessicant Module:
 - d. Mounting: Uni-strut.
 - 8. Classification: Suitable for Class 1, Division 2 environment.
- 2.8 LEVEL TRANSMITTER, ELECTRONIC LIT 1-2-Y(Y=1 THRU 34), LIT-1-3-Z (Z=1GW12, 1GW39, 1GW9, 1GW35, 1GW36, 1GW37, 1GW4, 1GW14, 1GW30), LIT-1-4-1

- 1. General:
 - a. Function: Measure pressure and transmit signal proportional to level.
 - b. Type: Electronic variable capacitance, two-wire transmitter.
- 2. Performance:
 - a. Range:
 - 1) LE 1-2-4: See Drawing C16.
 - 2) LE 1-3-2: 0 to 20 feet.
 - 3) LE 1-4-1: 0 to 20 feet.
 - b. Maximum Adjustable Range: Such that the noted range shall lie between 40 percent and 80 percent of the maximum adjustable range.
 - c. Accuracy: Plus or minus 0.25 percent of calibrated span.
 - d. Temperature: Minus 10 degrees F to plus 200 degrees F, minimum.
- 3. Features:
 - a. Type: Transducer, signal conditioning type compatible with pressure element.
 - b. Indicator: As required.
 - c. Suppressed or Elevated Zero: When noted.
 - d. Materials: Wetted parts including process flanges and drain/vent valves, 316 stainless steel, unless otherwise noted.
 - e. Wetted O-Rings: Viton, unless otherwise noted.
 - f. Housing: Modular with separate compartments for electronics and pressure connections.
 - g. Fill Fluid: Silicone, unless otherwise noted.
- 4. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 500 ohms minimum without load adjustment.
- 5. Enclosure:
 - a. Type: NEMA 4X, unless otherwise noted.
 - b. Mounting: Wall as noted. Provide brackets with stainless steel bolts.

2.9 LEVEL ELEMENT AND TRANSMITTER, ULTRASONIC LE/LIT-10-1

- 1. General:
 - a. Function: Provide continuous noncontacting level measurement with output proportional to level being sensed.
 - b. Type: Ultrasonic.
 - c. Parts: Level element, transmitter, and cable for connection from element to transmitter.
- 2. Service:
 - a. Medium: Liquids, slurries, solids, granulated solids.
 - b. Pressure: Atmospheric.
 - c. Temperature Range: Level element shall be capable of operating in range of minus 10 to 120 degrees F, while transmitter shall be

- capable of operating from 30 to 120 degrees F.
3. Performance:
 - a. Range: As required.
 - b. Zero Reference: As required.
 - c. Accuracy: Plus or minus 0.5 percent of full scale for analog output signal and alarm set points shall be repeatable within plus or minus 1 percent of full scale.
 - d. Resolution: 2 mm or 0.1 percent of range, whichever is greater.
 4. Features:
 - a. Unit shall be provided with output indicating meter with four-character LCD display programmable in engineering units of; feet, inches, meters, centimeters, or percent of span; and eight standard tank shape volume conversions.
 - b. Interconnecting Cable: Cable between level element and transmitter shall be supplied with unit, maximum length 1,200 feet.
 - c. Discrete Outputs: Transmitter shall provide up to four discrete outputs, each adjustable over entire scale range by screwdriver or programming module.
 - d. Alarm Messages: Loss of echo and cable circuit open or shorted.
 5. Signal Interface:
 - a. Transmitter Output: 4 to 20 mA dc output for load impedance of 0 to 600 ohms. Output shall also be reversible, 4 to 20 mA over range selection.
 - b. Power Supply: Unit shall operate on 120-volt, 50/60-Hz power.
 - c. Discrete Outputs: Unit shall transfer SPDT contacts rated at 5 amperes, noninductive, continuous, at 120V ac.
 6. Element:
 - a. Type: Shall be of a waterproof/weatherproof design for outdoor installation.
 - b. Process Connection: As required.
 7. Transmitter:
 - a. Transmitter shall be mounted in a NEMA 4 enclosure, unless otherwise noted, suitable for mounting as noted or shown.
 - b. Mounting: Wall, unless otherwise noted. Provide stainless bolts for outdoor applications.

2.10 PRESSURE DIFFERENTIAL TRANSMITTER, ELECTRONIC PE/PIT-8-1

1. General:
 - a. Function: Measure differential pressure and transmit signal proportional to differential pressure, flow, or level.
 - b. Type: Electronic variable capacitance, two-wire transmitter.
 - c. Parts: Transmitter and three-valve manifold.
2. Performance:
 - a. Range: As noted.
 - b. Maximum Adjustable Range: Such that the noted range shall be between 40 percent and 80 percent of the maximum adjustable range.
 - c. Accuracy: Plus or minus 0.25 percent of calibrated span between 4 and 100 percent of input differential pressure.
 - d. Temperature: Operating range minus 20 degrees F to plus 150 degrees F, minimum.
3. Features:
 - a. Square Root Extraction.
 - b. Damping: Fluid or electronic type with adjustment.
 - c. Indicator: 0 to
 - d. Elevated Zero.
 - e. Materials: Wetted parts including process flanges and drain/vent valves, 316 stainless steel, unless otherwise noted.
 - f. Wetted O-Rings: Viton, unless otherwise noted.

- g. Housing: Modular with separate compartments for electronics and field connections.
- h. Fill Fluid: Silicone, unless otherwise noted.
- 4. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 500 ohms minimum without load adjustment with 24V dc supply.
- 5. Enclosure:
 - a. Type: NEMA 4X, unless otherwise noted.
 - b. Mounting: Pipe or wall as noted. Provide brackets with Series 300 stainless steel bolts.
- 6. Three-Valve Manifold:
 - a. Provide unless otherwise noted.
 - b. Materials: 316 stainless steel.

2.11 PRESSURE GAUGE PI-1-2-Y (Y=1 THRU 34), PI-7, PI-9

- 1. General:
 - a. Function: Pressure indication.
 - b. Type:
 - 1) Direct reading bellows for ranges below 10 psig.
 - 2) Bourdon tube actuated for ranges 10 psig and above.
- 2. Performance:
 - a. Range: As noted. Compound scale when noted.
 - b. Accuracy: Plus or minus 0.5 percent of span.
- 3. Features:
 - a. Mounting: Lower stem, unless otherwise noted.
 - b. Dial: 4-1/2-inch diameter, unless otherwise noted.
 - c. Case Material: Phenolic plastic, unless otherwise noted.
 - d. Element Material: Phosphor-bronze, unless otherwise noted.
 - e. Dampening: Pulsation dampener when noted, piston type with multiple choice of piston placement to vary the desired amount of dampening.
 - f. Case Type: Solid front design with solid wall between window and element. Rear of case, gasketed pressure relief.
 - g. Pointer: Micrometer pointer with self-locking adjustment.
 - h. Movement: Stainless steel, rotary geared.
 - i. Submersible in water.
- 4. Process Connection:
 - a. Line Size: As noted.
 - b. Connection Type: Threaded.
- 5. Provide with Pressure Seal, Diaphragm: See paragraph 2.13.

2.12 PRESSURE TRANSMITTER, ELECTRONIC PE/PIT-2-1

- 1. General:
 - a. Function: Measure pressure and transmit signal proportional to pressure or level.
 - b. Type: Electronic force transfer, two-wire transmitter.
- 2. Performance:
 - a. Range: As noted.
 - b. Maximum Adjustable Range: Such that the noted range shall lie between 60 percent and 80 percent of the maximum adjustable range.
 - c. Accuracy: Plus or minus 0.25 percent of calibrated span.
 - d. Temperature: Minus 20 degrees F to plus 160 degrees F, minimum.
- 3. Features:
 - a. Type: Gauge pressure or absolute pressure, as noted.
 - b. Damping: Fluid or electronic type with adjustment.
 - c. Indicator: 0 to 100 psi.
 - d. Suppressed or Elevated Zero: When noted.
 - e. Materials: Wetted parts including process flanges, 316

- stainless steel, unless otherwise noted.
- f. Wetted O-Rings: Viton, unless otherwise noted.
- g. Housing: Modular with separate compartments for electronics and field connections.
- 4. Signal Interface: 4 to 20 mA dc output for load impedance of 0 to 500 ohms minimum without load adjustment with 24V dc supply.
- 5. Enclosure:
 - a. Type: NEMA 4X, unless otherwise noted.
 - b. Mounting: Pipe or wall as noted. Provide brackets with stainless steel bolts.

2.13 PRESSURE SEAL, DIAPHRAGM

- 1. General:
 - a. Function: Isolate sensing element from process fluid.
 - b. Type: Fluid filled, corrosion resistant.
- 2. Service:
 - a. Pressure: Same as associated sensor.
 - b. Temperature: As noted.
- 3. Features:
 - a. Materials:
 - 1) Lower Housing: 316 stainless steel, unless otherwise noted.
 - 2) Diaphragm Material: 316 stainless steel, unless otherwise noted.
 - b. Bleed screw in upper housing.
 - c. Fill Fluid: As noted. Factory filled and assembled when possible.
- 4. Process Connections:
 - a. Instrument: 1/2-inch female NPT, unless otherwise noted.
 - b. Process: 1/2-inch female NPT, unless otherwise noted.
 - c. Connection Material: As noted.

2.14 WARNING LIGHT, STROBE TYPE QL-1-1, QL-1-2

- 1. General:
 - a. Function: Visual alarm.
 - b. Type: Strobe light.
 - c. Parts: Light and spare bulbs.
- 2. Performance:
 - a. Temperature, Operating: Minus 35 to 190 degrees F.
 - b. Flash Rate: Nominally 90 per minute.
- 3. Features:
 - a. Dome Color: Blue.
 - b. Lamp Life: 200 hours.
 - c. Lamp: Strobe.
- 4. Enclosure:
 - a. Type: Water-resistant closed cell neoprene gasket.
 - b. Mounting: Wall bracket, unless otherwise noted.
 - c. UL Listing: Indoor/outdoor use.
- 5. Power: 120V ac, 50/60-Hz.
- 6. Spare Bulbs: Two for each light.

2.15 HORN QA-1-1

- 1. General:
 - a. Function: Audible alarm.
- 2. Performance:
 - a. Temperature, Operating: Minus 65 to 150 degrees F.
 - b. Sound Output Level: 100 dB nominal at 10 feet.

3. Features:
 - a. Dimensions: 4-3/8 inches in height and width, and 2.5 inch depth, for horn and enclosure.
 - b. Diaphragm: Stainless steel.
 - c. Projector: None, unless otherwise noted.
 - d. Listings: UL listed, FM, CSA approved.
4. Enclosure:
 - a. Type: Cast aluminum neoprene-gasketed weatherproof housing.
 - b. Mounting: Surface mount.
5. Power: 120V ac, 50/60-Hz, unless otherwise noted.

2.16 AUTODIALER

1. Telephone alarm system shall monitor external normally open contacts and upon a contact closure shall dial preprogrammed telephone numbers, deliver a prerecorded message, and reset itself upon reception of a signal from the person being called. Unit shall have two independent channels, unless otherwise noted. For each channel, the unit shall monitor a separate external normally open contact, have a list of preprogrammed telephone numbers, and have a prerecorded message.
2. The telephone alarm system shall have an adjustable time delay on initiation with a range of 0 to 90 seconds. If, during this time delay or at any time during the alarm sequence, the monitor contact reopens, the unit shall reset itself to its monitoring condition.
3. Unit shall be capable of storing four eight-digit telephone numbers per channel and shall call them in sequence until acknowledged. If a called number is busy, does not answer, or if an incorrect number is reached, the alarm system shall call the next number in the sequence. Dialing system shall be compatible with touch-tone or rotary exchanges.
4. Telephone alarm system shall be capable of storing a message with a minimum length of 30 seconds for each channel. Recorded message shall be of high quality and unit shall have positive mechanisms to prevent tape fouling after long periods of inactivity.
5. Unit shall share and shall not interfere with regular telephone line, and shall not require dedicated or leased line. Where remote test is noted, system shall require separate line. Connection to the telephone line shall be through an alarm coupler furnished by the local telephone company. Telephone alarm system shall provide connecting cable and all necessary power and control switching to operate the coupler. All dial pulses and message transmissions shall meet the requirements of the local telephone company.
6. Unit shall be powered by 120-volt, 60-Hz and shall contain rechargeable batteries and charging circuitry. Batteries shall provide a minimum of 8 hours' monitor service and 1/2 hour of alarm service. Unit shall be mounted in a NEMA 1 enclosure suitable for wall mounting.

PART 3 EXECUTION

3.1 INSTALLATION

General Requirements: Install all equipment in accordance with manufacturers' printed instructions and drawings.

3.2 SUPPLEMENTS

Supplements listed below, following "End of Section," are part of this Specification.

- a. Instrument Calibration Sheet.
- b. I&C Valve Adjustment Sheet.
- c. Performance Acceptance Test Sheet.

-- End of Section --

CH2M HILL

INSTRUMENT CALIBRATION SHEET

Rev.06.05.92

COMPONENT				MANUFACTURER				PROJECT				
Code:				Name:				Number:				
Name:				Model:				Name:				
				Serial #:								
FUNCTIONS												
	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? Y / N				CONTROL? Y / N				
Indicate? Y / N Record? Y / N	Chart:			Describe:				Action? direct / reverse				
	Scale:							Modes? P / I / D				
Transmit/ Convert? Y / N	Input:							SWITCH? Y / N				
	Output:							Unit Range:				
								Differential: fixed/adjustable				
								Reset? automatic / manual				
ANALOG CALIBRATIONS							DISCRETE CALIBRATIONS					Note No.
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.	Trip Point	Reset Pt.	
			Indicated	Output	Indicated	Output						
							1					
							2					
							3					
							4					
							5					
							6					
							7					
CONTROL MODE SETTINGS:			P:	I:	D:							
#	NOTES:										Component Calibrated and Ready for Start-up By: _____ Date: _____ Tag No.: _____	

INSTRUMENT CALIBRATION SHEET

EXAMPLE - ANALYZER/TRANSMITTER

COMPONENT				MANUFACTURER				PROJECT				
Code: A7				Name: Leeds & Northrup				Number: WDC30715.B2				
Name: pH Element & Analyzer/Transmitter				Model: 12429-3-2-1-7				Name: UOSA AWT PHASE 3				
				Serial #: 11553322								
FUNCTIONS												
Indicate? Y Record? N	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? N				CONTROL? N				
	Chart:			Describe:				Action? direct / reverse Modes? P / I / D				
Transmit/ Convert? Y	Scale:	1-14	pH units					SWITCH? N				
	Input:	1-14	pH units					Unit Range:				
	Output:	4-20	mA dc					Differential: fixed/adjustable				
								Reset? automatic / manual				
ANALOG CALIBRATIONS							DISCRETE CALIBRATIONS					Note No.
REQUIRED			AS CALIBRATED				REQUIRED			AS CALIBRATED		
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.	Trip Point	Reset Pt.	
			Indicated	Output	Indicated	Output						
1.0	1.0	4.0	1.0	4.0	1.0	3.9	1	N.A.		N.A.		
2.3	2.3	5.6	2.2	5.5	2.3	5.6	2					1.
7.5	7.5	12.0	7.5	11.9	7.5	12.0	3					
12.7	12.7	18.4	12.7	18.3	12.6	18.3	4					
14.0	14.0	20.0	14.0	20.0	14.0	20.0	5					
							6					
CONTROL MODE SETTINGS:			P: N.A.	I:	D:		7					
#	NOTES:										Component Calibrated and Ready for Start-up	
	1. Need to recheck low pH calibration solutions.											
											By: J.D. Sewell	
											Date: Jun-6-92	
											Tag No.: AIT-12-6[pH]	

PARTS	Project Name:		Project Number:		
Body	Type:		Mfr:		
	Size:		Model:		
	Line Connection:		Serial #:		
Operator	Type:		Mfr:		
	Action:		Model:		
	Travel:		Serial #:		
Positioner	Input Signal:		Mfr:		
	Action:		Model:		
	Cam:		Serial #:		
Pilot Solenoid	Action:		Mfr:		
	Rating:		Model:		
			Serial #:		
I/P Converter	Input:		Mfr:		
	Output:		Model:		
	Action:		Serial #:		
Position Switch	Settings:		Mfr:		
	Contacts:		Model:		
			Serial #:		
Power Supply	Type:		Air Set Mfr:		
	Potential:		Model:		
			Serial #:		
ADJUSTMENTS	Initial	Date	VERIFICATION	Initial	Date
Air Set			Valve Action		
Positioner			Installation		
Position Switches			Wire Connection		
I/P Converter			Tube Connection		
Actual Speed					
REMARKS:				Valve Ready for Start-up	
				By:	
				Date:	
				Tag No.:	

I&C VALVE ADJUSTMENT SHEET
EXAMPLE

PARTS	Project Name: <i>SFO SEWPCP</i>		Project Number: <i>SFO10145.G2</i>		
Body	Type: <i>Vee-Ball</i>		Mfr: <i>Fisher Controls</i>		
	Size: <i>4-inch</i>		Model: <i>1049763-2</i>		
	Line Connection: <i>159 # ANSI Flanges</i>		Serial #: <i>1003220</i>		
Operator	Type: <i>Pneumatic Diaphragm</i>		Mfr: <i>Fisher Controls</i>		
	Action: <i>Linear - Modulated</i>		Model: <i>4060D</i>		
	Travel: <i>3-inch</i>		Serial #: <i>2007330</i>		
Positioner	Input Signal: <i>3-15 psi</i>		Mfr: <i>Fisher Controls</i>		
	Action: <i>Direct - air to open</i>		Model: <i>20472T</i>		
	Cam: <i>Equal percentage</i>		Serial #: <i>102010</i>		
Pilot Solenoid	Action:		Mfr:		
	Rating: <i>None</i>		Model:		
			Serial #:		
I/P Converter	Input: <i>4-20 mA dc</i>		Mfr: <i>Taylor</i>		
	Output: <i>3-15 psi</i>		Model: <i>10-T-576-3</i>		
	Action: <i>Direct</i>		Serial #: <i>1057-330</i>		
Position Switch	Settings: <i>Closed / Open 5 deg. rising</i>		Mfr: <i>National Switch</i>		
	Contacts: <i>Close / Close</i>		Model: <i>1049-67-3</i>		
			Serial #: <i>156 & 157</i>		
Power Supply	Type: <i>Pneumatic</i>		Air Set Mfr: <i>Air Products</i>		
	Potential: <i>40 psi</i>		Model: <i>3210D</i>		
			Serial #: <i>1107063</i>		
ADJUSTMENTS	Initial	Date	VERIFICATION	Initial	Date
Air Set	<i>JDS</i>	<i>Jun-06-92</i>	Valve Action	<i>JDS</i>	<i>Jun-03-92</i>
Positioner	<i>JDS</i>	<i>Jun-06-92</i>	Installation	<i>JDS</i>	<i>Jun-03-92</i>
Position Switches	<i>JDS</i>	<i>Jun-06-92</i>	Wire Connection	<i>JDS</i>	<i>Jun-04-92</i>
I/P Converter	<i>JDS</i>	<i>Jun-07-92</i>	Tube Connection	<i>JDS</i>	<i>Jun-04-92</i>
Actual Speed	<i>JDS</i>	<i>Jun-07-92</i>			
REMARKS: <i>Valve was initially installed backwards.</i> <i>Observed to be correctly installed May-25-92</i>				Valve Ready for Start-up	
				By: <i>J.D. Sewell</i>	
				Date: <i>Jun-07-92</i>	
				Tag No.: <i>FCV-10-2-1</i>	

Project Name:

Project No.:

Demonstration test(s): For each functional Requirement of the loop:

(a) List and number the requirement. (b) Briefly describe the demonstration test.

(c) Cite the results that will verify the required performance. (d) Provide space for signoff.

Forms/Sheets Verified	By	Date	Loop Accepted By Owner
Loop Status Report			By:
Instrument Calibration Sheet			Date:
I&C Valve Calibration Sheet			
Performance Acceptance Test	By	Date	
Performed			
Witnessed			Loop No.:

[illegible]

SECTION 13112

CATHODIC PROTECTION SYSTEM (STEEL WATER TANKS)
12/95

PART 1 GENERAL

1.1 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 3 (1990) Soft or Annealed Copper Wire

ASTM B 8 (1993) Concentric-Lay-Stranded Copper
Conductors, Hard, Medium-Hard, or Soft

ASTM D 1248 (1984; R 1989) Polyethylene Plastics
Molding and Extrusion Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control and Systems
Controllers, Contactors and Overload
Relays, Rated Not More Than 2000 Volts AC
or 750 Volts DC

NEMA ICS 3 (1993) Factory Built Assemblies

NEMA FU 1 (1986) Low Voltage Cartridge Fuses

NEMA ST 1 (1988) Specialty Transformers (Except
General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 6 (1993; Bul. 1993) Rigid Metal Conduit

UL 83 (1991; Bul. 1991, 1993, and 1994, R 1994)
Thermoplastic-Insulated Wires and Cables

UL 467 (1993; Bul. 1994) Grounding and Bonding
Equipment

UL 486A (1991; Errata 1991 and 1992, R 1992, Bul.
1993 and 1994) Wire Connectors and

	Soldering Lugs for Use With Copper Conductors
UL 489	(1991; Bul. 1992, 1993, 1994, and 1995, R 1994) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 506	(1994; R 1994, Bul. 1994) Specialty Transformers
UL 510	(1994; R 1994) Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1991; R 1993, Bul. 1993 and 1994) Metallic Outlet Boxes
UL 514B	(1989; Errata 1991, R 1993, Bul. 1993 and 1994) Fittings for Conduit and Outlet Boxes

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," and Section 16402, "Interior Distribution System," apply to this section except as modified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Rectifiers
- b. Impressed current anodes
- c. Permanent reference electrodes

1.3.1.1 Impressed Current Anodes

Include certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density.

1.3.2 SD-04, Drawings

- a. Rectifier installation
- b. Anode installation
- c. Wiring and schematic diagram
- d. Anode junction boxes

1.3.3 SD-05, Design Data

- a. Cathodic protection design G

1.3.4 SD-08, Statements

- a. Qualifications of corrosion engineer G

1.3.5 SD-12, Field Test Reports

- a. Initial field testing G
- b. Warranty period testing G
- c. Final field testing G
- d. Ground resistance testing G

1.3.6 SD-19, Operation and Maintenance Manuals

- a. Cathodic Protection System, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.4 SERVICES OF CORROSION ENGINEER

The Contractor shall obtain the services of a corrosion engineer to design, supervise, inspect and test the installation of the cathodic protection system. Corrosion Engineer refers to a person, who, by reason of their knowledge of the physical sciences, the principles of engineering and mathematics as acquired by a professional education and related practical experience, is qualified to engage in the practice of corrosion control of underground storage tanks and pipelines. Such a person will be a registered professional engineer with certification of licensing that includes education and experience in cathodic protection of buried or submerged metal structures, or a person accredited or certified by the National Association of Corrosion Engineers at the level of Corrosion Specialist or Cathodic Protection Specialist. Such a person shall have not less than five years experience in the cathodic protection of underground storage tanks and pipelines.

1.5 CATHODIC PROTECTION DESIGN

The contractor's corrosion engineer shall provide a complete cathodic protection system design for the underground storage tank utilizing a galvanic anode or impressed current cathodic protection system, as applicable for the site. The design shall include test stations with permanent copper-copper sulfate reference electrodes for system testing and long-term monitoring. The cathodic protection system shall be designed in accordance with NACE RP0169, NACE RP0285, and NACE RPO388.

1.5.1 Impressed Current Design

The minimum acceptable impressed current system design will be a fused disconnect switch supplying AC power to a manual rectifier, High Silicon Chromium Bearing Cast Iron (HSCBCI) anodes surrounding the underground storage tank, test station for structure and reference electrode connections and copper-copper sulfate reference electrodes located 12 inches from tank wall. The design shall include:

- a. Fused disconnect switch, wall or post mounted.

- b. Manual rectifier, wall or post mounted.
- c. HSCBCI anodes vertically installed around tank for even distribution of current. Top of anodes to be below centerline of tank. Each anode shall be in a coke breeze backfill not less than 3 inches thick. Prepackaged anodes may be utilized. Minimum anode life to be not less than 15 years.
- d. HMWPE insulated conductors for structure lead wire, anode lead wires, and anode header cables.
- e. Additional design requirements as indicated herein.

1.5.2 Additional Design Requirements

The cathodic protection system design shall include:

- a. Flush mounted and/or post mounted anode test stations, as applicable, for cathodic protection system operation and monitoring.
- b. Copper-copper sulfate reference electrodes connected at each test station for system monitoring by the Government. Reference electrodes will be located near the protected structure to minimize IR drop. Provide separate structure lead wire connection for potential monitoring in each test station.
- c. Current requirement to be not less than 2 milliamps per square foot of bare steel. Include estimated coating efficiency for current requirement calculations.
- d. Provide soil resistivity measurements obtained onsite utilizing the Wenner four pin method.
- e. Provide all design calculations, assumptions, and field measurements with the contractor design drawings.
- f. Dielectric isolation of underground storage tank from unprotected pipelines and structures.
- g. Exothermic welding of wires to underground storage tank.
- h. All underground splices shall be cast epoxy type.
- i. Provide cable identification tape 12 inches above direct buried cable or conduit.
- j. Provide pavement inserts when underground tank is beneath concrete or asphalt pavements.

PART 2 PRODUCTS

2.1 Impressed Current Anodes

2.1.1 Precious Metal Anodes

Provide precious metal anodes solid wire in form. Anode core shall be copper with a niobium or titanium substrate and platinum coating thickness of 7 mils, minimum. Size as required.

Precious metal anode wire shall be provided with a suitable suspension system (buoyant or spider rope system) to resist damage by ice formation. Support for suspension system shall be anchoring devices welded to the tank wall. Anode wire shall be located and designed in such a manner to provide cathodic protection continuously during minimum and maximum water levels.

2.2 ATTACHMENT OF ANODE CABLE

Wire anode shall have connecting cables brazed or welded to the anode header cable.

2.3 RECTIFIERS

Provide rectifier consisting of a transformer, rectifying elements, transformer tap adjuster, terminal panel, one D.C. output voltmeter, one D.C. output ammeter, one toggle switch for each meter, fuse holder with fuses of each D.C. circuit, an A.C. power-supply circuit breaker, and lightning arresters for both input and output; all wired and assembled in a weatherproof metal cabinet. Overall efficiency of the rectifier not less than 65 percent within operated at nameplate rating and capable of supplying continuous full rated output at an ambient temperature of 112 degrees F in full sunlight with expected life in excess of 10 years.

2.3.1 Transformers

UL 506 and NEMA ST 1, as applicable.

2.3.2 Electrical Ratings

Electrical ratings as follows: Input voltage at 60 Hz: 115 volts single phase

a. Output voltage, dc: As determined by designer of system.

b. Output current, dc: As determined by designer of system.

2.3.3 Rectifying Elements

Provide silicon diode rectifying elements, connected in such manner as to provide full-wave rectification.

2.3.4 Enclosure

NEMA ICS 2, NEMA ICS 3, Type 3R, suitable for wall or post mounting. Enclosure shall include hinged door with padlock hasp. Fit enclosure with screened openings to provide for cooling by natural convection. Provide holes, conduit knockouts and threaded hubs of sufficient size and location.

2.3.5 Wiring and Schematic Diagram

A complete wiring and schematic diagram of the power unit showing both the A.C. and the D.C. connections to anodes shall be on the inside of the cabinet door. Show and label components.

2.3.6 Coating

Coat the enclosure and supporting mounting with the manufacturer's standard system.

2.3.7 Overload and Short Circuit Protection

UL 489, single-pole, flush-mounted molded case circuit breaker, thermal-magnetic type, shall be installed in the primary circuit of the rectifier supply transformer.

2.3.8 Output Voltage and Current Meters

Provide separate panel voltmeter and ammeter, not less than 2 1/2 inch rectangular accurate to within plus or minus 2 percent of full scale at 80 degrees F, and shall possess temperature stability above and below 80 degrees F of at least 1 percent per 10 degrees F. Provide toggle switch for each meter.

2.3.9 Grounding Provisions

NFPA 70 and UL 467, including a grounding terminal in the cabinet. The grounding conductor from the terminal to the earth grounding system shall be solid or stranded copper not smaller than No. 6 AWG. The earth grounding system shall consist of one or more 5/8-inch diameter copper-clad steel rods. Provide minimum 8 feet long ground rod.

2.3.10 Fuses

Cartridge-type fuses conforming to NEMA FU 1. Provide suitable fuse holders in each leg of the D.C. circuit.

2.4 REFERENCE ELECTRODES

Bare zinc type with insulated lead wire.

2.5 AUTOMATIC CATHODIC PROTECTION CONTROL

Provide system capable of maintaining a preselected tank-to-water potential, within plus or minus 0.025 volt regardless of changes in water chemistry, temperature, or water level in the tank. Provide separate D.C. output circuits, means of adjustment, reference electrodes, and metering for the tank bowl. Provisions shall be made for readily changing the range and limits of the operating potential.

2.6 SHUNT RESISTORS

If shunts are required, they shall have an accuracy of plus or minus one percent and have a rating as determined by the system designer.

2.7 CONDUIT

UL 6, rigid galvanized steel. Outlet boxes: UL 514A and Fitting: UL 514B, threaded hubs. Provide conduit support in accordance with NFPA 70.

2.8 CABLE

D.C. wire, other than in conduit runs, shall be stranded copper wire with Type CP high molecular weight polyethylene (HMWPE) insulation, 7/64 inch thick, 600 volt rating, in accordance with ASTM D 1248. UL 83, Type THHN or THWN, stranded copper conductor, color coded as indicated. Lead wires terminating in a junction box or test station shall have a cable identification tag. Copper wires shall conform to ASTM B 3 and ASTM B 8.

2.8.1 Anode Wire

No. 8 AWG. Wire-to-anode contact resistance shall be 0.003 ohms maximum.

2.8.2 Anode Header Cable

As determined by system designer.

2.8.3 Reference Electrode Wire

No. 14 AWG.

2.8.4 Cable Identifier Tags

Stainless steel material with stamped or engraved letters. Print letters and numbers a minimum 3/16 inch in size.

2.8.5 Wire Connectors

UL 486A.

2.8.6 Insulating Tape

UL 510.

2.8.7 Splices

Cast epoxy type.

2.8.8 Polyethylene Insulation

ASTM D 1248 and of the following types, classes, and grades:

- a. High molecular weight polyethylene, Type I, Class C, Grade E5.

2.9 EXOTHERMIC WELD KITS

Exothermic weld kits specifically designed by the manufacturer for welding the types of materials and shapes provided.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Anode Installation

ANSI C2 and NFPA 70.

3.1.1.1 Icing Climates

Suspend anodes in a manner to prevent the anodes and suspending cables from being damaged by freezing or falling ice. Contractor shall certify that the method has been used successfully for similar applications.

3.1.1.2 Anode Placement

Arrange anodes in the tank so that protection can be provided to surfaces without exceeding potentials in the vicinity of the anodes that will be

detrimental to coatings. Suspend anodes from roof by means of factory-installed connecting wire designed to support the anodes without failure of the electrical wire insulation or the electrical conductors. Prevent contact between anode and tank surfaces such as man-access hatches, as ladders, heater pipes, and stay rods.

3.1.1.3 Anode Hangers

Anode hangers shall electrically insulate the anode suspending wire from the tank steel.

3.1.2 Anode Connection

3.1.2.1 Anode Lead Wires

Electrically connect anodes to the positive D.C. header cable with compression connectors or split bolts, or the header cable may terminate in a junction box for connection with all anodes cables. Use a minimum of two split bolts for each connection if split bolts are used.

3.1.2.2 Anode Header Cable

Provide header cable on the access tube with electrically insulating hangers which shall enter the tank near the top of the access tube from an externally mounted junction box. External wiring shall be in conduit.

3.1.2.3 Splices

Locate under-roof electric wire splices above the high water line and seal water-tight with cast epoxy splice kits.

3.1.3 Rectifiers

3.1.3.1 Rectifier Installation

Location and mounting as indicated.

3.1.3.2 Wire-To-Structure Connections

Connect wire-to-structure (negative) by use of an exothermic weld kit. Clean the structure surface by scraping, filing, or wire brushing to produce a clean, bright surface. Weld connections using the exothermic weld kits in accordance with the manufacturer's instructions. Test the integrity of the weld, prior to coating, by striking with a two pound hammer. Cover connections and surrounding cleaned surface with an electrically insulating coating compatible with the existing coating.

3.1.4 Permanent Reference Electrodes

3.1.4.1 Calibration

Calibrate permanent reference electrodes against a portable electrode before installation. Calibrate in a test tank containing water with the same composition as the tank to be protected. Permanent electrode shall measure a reference potential agreeing with that measured by the portable electrode within plus or minus 0.010 volt when the two electrodes being compared are not more than 1/6-inch apart but not touching.

3.1.4.2 Installation

Provide permanent reference electrodes at points in the tank which shall monitor minimum and maximum tank-to-water potentials and for automatic control system, and maintain continuous immersion. The reference electrodes shall be equidistant to and located within 1 inch of the steel tank surface and shall be fixed in position, preventing contact with tank wall or appurtenances.

3.2 GASEOUS EVOLUTION

Provide for possible evolution of gases from anode reaction and ventilation requirements.

3.3 CRITERIA FOR CATHODIC PROTECTION

3.3.1 Minimum

The criterion for cathodic protection shall be a negative potential of at least 0.85 volt as measured between the tank and a copper-copper sulfate reference electrode across the tank to water interface. Determination of this potential shall be made with the cathodic protection system in operation.

3.3.2 Maximum

The potential between a copper-copper sulfate reference electrode and the tank at any point shall not be more negative than 1.1 volt with the electrode located within 1 inch of the tank surface but not touching it.

3.4 FIELD QUALITY CONTROL

Field tests shall be witnessed by the Contracting Officer or his designated representative. Advise the Contracting Officer 5 days prior to performing each field test. Quality control for the cathodic protection systems shall consist of the following:

- a. Initial field testing by Contractor upon construction.
- b. Government field testing after initial field test report submission.
- c. Warranty period field testing by Contractor.
- d. Final field testing by Contractor after one year of service.

3.4.1 Testing

3.4.1.1 Destructive Testing

One completed prepackaged anode of each type with lead wires shall be chosen at random for destructive testing and shall be submitted to a static pull test. Anode lead wire connections of anodes shall have sufficient strength to withstand a minimum tensile load of 300 pounds. Contractor shall perform the tests in the presence of the Contracting Officer.

3.4.1.2 Wire for Power Service

Test wire for power service at 600 volts or less to determine that the wiring system and equipment are free from short circuits and grounds by a

minimum of two megohms. Perform the test with a megohmmeter having a 500-volt rating.

3.4.1.3 Cathodic Protection System Initial Field Testing

The systems shall be tested and inspected by the Contractor's corrosion engineer in the presence of the Contracting Officer's corrosion protection engineer or an approved representative. Record test data, including date, time, and locations of testing and submit report to the Contracting Officer. Contractor shall correct, at his expense, all deficiencies in the materials and installation observed by these tests and inspections. Contractor shall pay for retests made necessary by the corrections. Testing shall include the following measurements:

- a. Base potentials: After initial operation of structures containing fluids for at least one week, but before energizing of the cathodic protection system, measure the native structure-to-electrolyte potentials of the structure. The locations of these measurements shall be identical to the locations specified for measuring energized structure-to-electrolyte potentials. Perform measurements at junction boxes, test stations or other locations suitable for test purposes (such as service risers or valves) at intervals not exceeding 50 feet with readings at each endpoint and the midpoint as a minimum. For underground tanks, take a minimum of three measurements with the reference electrode located.
 - (1) Directly over the center of the tank.
 - (2) At a point directly over the tank and midway between each pair of anodes.
 - (3) At each end of the tank.
- b. Reference Electrode Calibration: Verify calibration of reference electrode by measuring potential difference between permanent copper-copper sulfate reference electrode and an independent reference electrode. Potential difference between the two electrodes shall not exceed 10 millivolts.
- c. Insulation testing: Perform insulation testing at each insulating joint or fitting before and after the cathodic protection system is energized. Before energizing, test using an insulation checker. After energizing, test the insulation by measuring the potential shift on both sides of the insulating joint. This testing shall demonstrate that no metallic contact or short circuit exists between the two insulated sections of the pipe. Report and repair defective insulating fitting at the Contractor's expense.
- d. Electrical continuity testing: Perform electrical continuity testing for joint bonded pipe prior to backfilling of the pipe. Circulate current through the pipe and compare the measured resistance to the theoretical resistance of the pipe and bond cables. The resistance measured shall not exceed 150 percent of the theoretical resistance.
- e. Rectifier system testing: Upon completion of the installation, energize and adjust each rectifier. Measure D.C. outputs of the

rectifier and current outputs of each anode at different rectifier settings. Measure the current outputs across the installed shunts. Verify these readings using portable, calibrated meters and shunts. This testing shall demonstrate if the rectifier system is capable of functioning properly as required to provide effective cathodic protection.

- f. Casing testing: Before final acceptance of the installation, test the electrical insulation of the carrier pipe from casings and correct any short circuits.
- g. Energized potentials: With the entire cathodic protection system put into operation for at least 24 hours measure pipe-to-soil potentials along the structure using a copper/copper sulfate reference electrode and a voltmeter having an input impedance of not less than 10 megohms. The locations of these measurements shall be identical to the locations used for the base potential measurements.
- h. Interference testing: Before final acceptance of the installation, perform interference testing with respect to any crossing and nearby foreign pipelines in cooperation with the owner of the related pipelines. The testing shall verify that the subject cathodic protection system does not have a deleterious effect on the foreign pipelines, and vice versa. Prepare a full report of the tests, giving all details.

3.4.1.4 Initial Test Report

The Contractor shall submit a field test report of the cathodic protection system. All structure-to-electrolyte measurements, including initial potentials and anode outputs, shall be recorded on applicable forms. Identification of test locations, test station and anode test stations shall coordinate with the as-built drawings and be provided on system drawings included in report. The contractor shall locate, correct and report to the Contracting Officer any short circuits encountered during the checkout of the installed cathodic protection system.

3.4.1.5 Government Field Testing

The Government corrosion engineer, LANTNAVFACENGCOM Code 404, shall review the initial field testing report. Approximately four weeks after receipt of the contractor's initial test report, the system will be tested and inspected in the Contractor's presence by the Government corrosion engineer. Contractor shall correct, at his expense, differences in the materials and installation observed by these tests and inspections. The Contractor shall pay for all retesting done by the Government corrosion engineer made necessary by the correction of deficiencies.

3.4.1.6 One Year Warranty Period Testing

The Contractor shall inspect, test, and adjust the cathodic protection system quarterly for one year, to ensure its continued conformance with the inspections outlined above. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of test report, including field data, certified by the Contractor's corrosion engineer, shall be forwarded to the Contracting Officer and the corrosion protection engineer, the activity,

and the geographic Engineering Field Division corrosion engineer, LANTNAVFACENGCOM Code 404.

3.4.1.7 Final Field Testing

Conduct final field testing of the cathodic protection system utilizing the same procedures indicated in the initial field testing of the cathodic protection system. The Contractor shall inspect, test, and adjust the cathodic protection system after one year of operation to ensure its continued conformance with the inspections outlined above. The performance period for these tests shall commence upon preliminary acceptance for the cathodic protection system by the Contracting Officer. Copies of final testing report, certified by the Contractor's corrosion engineer, shall be submitted to the Contracting Officer and the Government corrosion engineer for approval and as an attachment to the operation and maintenance manual in accordance with Section 01781, "Operation and Maintenance Data".

3.4.2 Criteria for Cathodic Protection of Steel Structures

Conduct in accordance with NACE RP0169. Criteria for determining the adequacy of protection shall be selected by the corrosion engineer as applicable:

- a. A negative voltage of at least 0.85 volt as measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the water. Determination of this voltage is to be made with the protective current applied to the structure for a minimum of 24 hours. Voltage drops must be considered for valid interpretation of this voltage measurement. Method of voltage drop consideration shall be identified by the contractors corrosion engineer and approved by the Government corrosion engineer.
- b. A minimum polarization voltage shift of 100 mV measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the electrolyte. This voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. At the instant the protective current is interrupted ("instant off"), an immediate voltage shift will occur. The voltage reading just after the immediate shift shall be used as the base reading from which to measure the polarization decay. The polarization decay shall be the difference between the base reading and a voltage measurement made 24 hours after the disruption of protective current.

3.4.3 Placing in Service

After final adjustments, place the cathodic protection system in service, record the relevant operating parameters of the system and indicate transformer tap settings; tank-to-water potentials, automatic control differential setting; A.C. supply voltage; adjusted D.C. output voltage; and total protective current.

3.5 DEMONSTRATION

3.5.1 Instructing Government Personnel

During the warranty testing and at a time designated by the Contracting

Officer, make available the services of a technician regularly employed or authorized by the manufacturer of the Cathodic Protection System for instructing Government personnel in the proper operation, maintenance, safety, and emergency procedures of the Cathodic Protection System. Period of instruction shall be not less than one but not more than two 8-hour working days. Conduct the training at the jobsite or at another location mutually satisfactory to the Government and the Contractor. The field instructions shall cover all of the items contained in the operation and maintenance manual.

-- End of Section --

SECTION 13121

PREENGINEERED METAL BUILDINGS
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1990) Quality Certification Program Description
AISC S329	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts
AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 529/A 529M	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 572/A 572M	(1994; Rev. C) High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM A 588/A 588M	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 653/A 653M	(1995) Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(1995) Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 792/A 792M	(1995) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus

ASTM B 221	(1995; Rev. A) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM D 522	(1993; Rev. A) Mandrel Bend Test of Attached Organic Coatings
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating Degree of Chalking of Exterior Paint Films
ASTM E 84	(1995; Rev. A) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM G 23	(1995) Operating Light-Exposure Apparatus (Carbon-Arc Type) with and Without Water for Exposure of Nonmetallic Materials

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel
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METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA LRMBSM	(1986; Supp. 1990) Low Rise Metal Building Systems Manual
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STEEL DECK INSTITUTE (SDEI)

SDEI DDM	(1990) Diaphragm Design Manual
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UNDERWRITERS LABORATORIES INC. (UL)

UL 580	(1994; Bul. 1994, R 1995) Uplift Resistance of Roof Assemblies
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1.2 DESCRIPTION OF BUILDING

1.2.1 Dimensions

Building dimensions shall be as standard with manufacturer, not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of finished floor to intersection of insides of roof and sidewall sheets. The clear height between finished floor and bottom of roof steel shall be as indicated.

1.2.2 Framing

Provide building with vertical walls and gable roof. Building shall be single-span structures with one of the following framing systems: rigid frame type, similar to AISC S335, Type I construction. End walls shall be of beam and column design. Roof slope shall be a minimum of 1 to 24. Design framed openings structurally.

1.2.3 Foundation Requirements

Foundations shall be as indicated and a concrete compressive strength as specified in Section 03300, "Cast-In-Place Concrete." The foundation loads are as indicated or as required by the building manufacturer.

1.3 EXPERIENCE

1.3.1 Manufacturer

The manufacturer shall have AISC FCD, category MB certification.

1.3.2 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.4 DESIGN REQUIREMENTS

MBMA LRMB SM, for loading combinations and definitions with the exceptions of wind load and special collateral loads. Design for each material shall be as specified by the Design Authority as listed in MBMA LRMB SM.

1.4.1 Roof Dead, Live, and Snow Loads

As indicated.

1.4.2 Wind Loads

Compute and apply wind pressures in accordance with MIL-HDBK-1002/2A. Basic wind speed and importance factors are as indicated.

1.4.3 Seismic Loads

As required for Seismic Zone 1 in accordance with NAVFAC P-355.

1.4.4 Collateral Loads

As indicated.

1.4.5 Deflection

1.4.5.1 Structural Members

The maximum deflection of main framing members shall not exceed 1/240th of their respective spans. The maximum deflection due to live load in roof panels and purlins shall not exceed 1/180th of their respective spans.

1.4.5.2 Roof Panels

UL 580, Class 90. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition, the roof decking shall be designed for a 200-pound concentrated load at midspan on a 12-inch wide section of deck.

1.4.5.3 Wall panels

The maximum deflection due to wind on wall panels and girts shall be limited to 1/120th of their respective spans except that when interior finishes are used the maximum allowable deflection shall be limited to 1/180th of their respective spans.

1.4.5.4 Openings

Limit deflections of steel framing above and along the side of rolling door openings to a maximum of 1/2 the allowable movement in the telescoping top roller of the doors to ensure proper operation. Frame all equipment openings over 12 inches by 12 inches.

1.5 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.5.1 SD-02, Manufacturer's Catalog Data

a. Preengineered metal building materials

Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

1.5.2 SD-03, Manufacturer's Standard Color Charts

a. Factory color finish

Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the Contracting Officer.

1.5.3 SD-04, Drawings

a. Preengineered building G

b. Template for anchor bolts

Submit as necessary to erect the building and install components.

1.5.3.1 Preengineered Building

Submit complete design drawings for the preengineered building. Submit drawings for the anchorage.

1.5.4 SD-05, Design Data

- a. Building G
- b. Foundation loads G
- c. Anchor bolts G
- d. Purlins and girts G
- e. Bracing G

1.5.4.1 Building

Submit design calculations for the entire preengineered building and foundations, prepared and stamped by a professional engineer registered in the State where the building is being erected. Also submit for components requested, and stamp with the seal of a professional engineer. Include sizes and location of anchor bolts.

1.5.5 SD-11, Factory Tests

- a. Factory Color Finish
- b. Insulation

1.5.6 SD-19, Operation and Maintenance Manuals

- a. Preengineered Building, data package 1

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle manufactured items so that materials remain dry and undamaged. Do not store in contact with materials that might cause staining.

1.7 WARRANTY

Provide warranty against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 20 years. Such warranty shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2 PRODUCTS

2.1 WALL AND ROOF MATERIALS

MBMA LRMBM except as specified otherwise herein. Design roof and wall panels, accessories, and flashings to be completely weathertight and free

of abrasions, loose fasteners, and deformations.

2.1.1 Minimum Thickness

As required to conform to design requirements but not less than the following:

<u>Items</u>	<u>Minimum Thickness (Uncoated)</u>
Steel Structural Members Other Than Roof and Wall Panels	18 Manufacturer's Standard (MFG STD) gage, 0.0478 inch
Roof Panels	24 MFG STD gage, 0.0179 inch
Steel Wall Panels	26 MFG STD gage, 0.0179 inch
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, and Liner Panels	
Steel	26 MFG STD gage, 0.0179 inch
Eave Gutters and Downspouts	
Steel	26 MFG STD gage, 0.0179 inch
Roof Ventilators	
Steel	26 MFG STD gage, 0.0179 inch

2.1.2 Panels

- a. Fabricated of zinc-coated steel or aluminum/zinc-coated steel except light transmitting roof panels indicated.
- b. Preformed.
- c. If designed as diaphragm, roof decks shall be designed in accordance with SDEI DDM.

Depth of the panel corrugations shall be 1 1/2 inch minimum. Panels over 30 feet in length shall be designed for thermal expansion and contraction.

2.1.2.1 Zinc-Coated Steel Sheet

ASTM A 755/A 755M, Coating Class G-90 or ASTM A 653/A 653M, SQ, Grade 33, Coating Class G-90.

2.1.2.2 Aluminum/Zinc-Coated Steel Sheet

ASTM A 792/A 792M, AZ 55.

2.1.2.3 Liner Panels for Walls and Roof

Formed of same type material as used for wall panels to closely approximate configuration of panels indicated.

2.2 FRAMING AND STRUCTURAL MEMBERS

2.2.1 Steel

ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M.

2.2.2 Structural Tube

ASTM A 500 or ASTM B 221.

2.3 MISCELLANEOUS ITEMS

2.3.1 Caps, Strips, and Plates

Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories from the same material and gage as the roof panels. Wall plates, base angles or base channels, and other miscellaneous framing members may be standard structural steel shapes, or may be formed from steel not lighter than 18 gage thick.

2.3.2 Closure Strips

Provide closure strips of closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering. Closure strips shall not absorb or retain water.

2.3.3 Sealant

Provide elastomeric type sealant containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.3.4 Gaskets and Insulating Compounds

Provide nonabsorptive gaskets and insulating compounds suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.3.5 Fasteners

Provide fasteners for steel wall and roof panels of corrosion resisting steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering.

2.3.5.1 Screws

Provide self-tapping screws not less than No. 14 diameter and not less than No. 12 diameter if self-drilling/self-tapping type.

2.3.5.2 End-Welded Studs

Provide automatic shouldered type studs with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

2.3.5.3 Bolts

Provide bolts not less than 1/4 inch diameter, shouldered or plain shank as required, with nuts.

2.4 GUTTERS

Provide complete with mitered corners, end pieces, and special pieces that may be required. Expansion-type slip joints shall be provided at the center of the runs and at intervals of not more than 32 feet for aluminum and not more than 40 feet for steel. Provide water tight seal at all other joints. Provide gutters below the slope line of the roof, to allow snow and ice to slide clear. Provide hangers and fastenings from a metal compatible with the gutters. Space hangers not more than 36 inches apart.

2.5 DOWNSPOUTS

Provide cross sectional area not less than the size of gutter indicated and complete including elbows and offsets. Provide downspouts in approximately 10-foot lengths; end joints shall telescope not less than 1/2 inch, and longitudinal joints shall be locked. Provide gutter outlets with stainless steel wire ball strainers of a standard type. Position downspouts not less than 1/2 inch away from walls and fasten to the walls at top, bottom, and at not to exceed 5 foot centers intermediately between with manufacturer's standard type leader straps, or concealed type fasteners. Form straps and fasteners from a metal compatible with the downspouts.

2.6 LOUVERS

Specified in Section 15810, "Ductwork and Ductwork Accessories." Provide framing and flashings as necessary for installation of louvers.

2.7 LIGHT TRANSMITTING ROOF PANELS (INSULATING)

Standard with the manufacturer of a nominal size of 3'-0" by 10'-6". The light transmitting roof panels shall consist of an interior and exterior plastic face with a sealed airspace of 1 to 1 1/2 inches. The exterior plastic face shall be not less than 0.055 inch thickness and shall have the same configurations as the roofing panels. The interior plastic face shall be not less than 0.035 inch thickness. Plastic faces shall be fiberglass consisting of polyester synthetic resin reinforced with a fibrous glass mat and rated self-extinguishing by Underwriters Laboratories Inc. The "U" factor of the light transmitting roof panels shall not be more than 0.50.

2.8 FIELD INSTALLED INSULATION

Blanket type 0.6 pound fiber-glass as standard with the metal building manufacturer having a factory-applied facing on one side and a permeance rating of 0.05 or less when tested in accordance with ASTM E 96.

- a. Facing on insulation shall be 0.002 inch thick aluminum foil.
- b. The insulation, including facings, shall have a flame spread rating of 75 or less and a smoke development factor of 150 or less when tested in accordance with ASTM E 84.
- c. Wall insulation shall have guarded hot box values for "R" of 19 or more as measured in accordance with ASTM C 236 test method. Roof

insulation shall have guarded hot box values for "R" of 30 or more as measured in accordance with ASTM C 236.

- d. Provide insulation containing 20 percent or greater recovered material which has been diverted from solid waste, but not including material reused in a manufacturing process. Where two materials have the same price and performance, provide the one containing the higher recovered material content.

2.9 DOORS AND WINDOWS

Steel doors and steel door and window frames are specified in Section 08110, "Steel Doors, Door Frames, and Window Frames;" rolling service doors are specified in Section 08331, "Rolling Service Doors;" door hardware is specified in Section 08710, "Door Hardware," and glazing is specified in Section 08800, "Glazing." Provide framing members and flashings as necessary for installation of the doors and windows.

2.10 FINISH

2.10.1 Shop Painting

Ferrous metal work, except factory-finished work, zinc-coated work, aluminum-coated work, and work specified to be painted herein, shall be (1) cleaned of dirt, rust, scale, loose particles, grease, oil, and other deleterious substances; (2) phosphate treated; and (3) then be given one coat of an approved rust-inhibiting primer paint of the type standard with the metal building manufacturer.

2.10.2 Factory Color Finish

Provide exterior and interior exposed surfaces of metal roof and wall panels, gutters, downspouts, and metal accessories with a thermal-cured factory finish. Color shall be selected from manufacturer's standard colors as indicated. Provide an exterior finish top coat of 70 percent resin fluoropolymer. Provide standard dry film thickness of 0.9 mil for exterior coating exclusive of primer. Provide exterior primer thickness standard with building manufacturer. Interior color finish shall consist of a backer coat with dry film thickness of 0.5 mil thick prime coat. Provide interior and exterior color finish meeting the test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided.

- a. Salt Spray Test: ASTM B 117, minimum 1000 hours. Undercutting of the paint film from the score line shall not exceed 1/16 inch.
- b. Accelerated Weathering Test: ASTM G 23, Method 2, Type D apparatus minimum 2000 hours or Type EH apparatus minimum 500 hours, no checking, blistering or loss of adhesion; color change less than 5 NBS units by ASTM D 2244 and chalking less than No. 8 rating by ASTM D 4214.
- c. Flexibility: ASTM D 522, Method A, 1/8 inch diameter, 180 degree bend, no evidence of fracturing to the naked eye.
- d. Adhesion: ASTM D 3359, Method B, for laboratory test and film thickness less than 5 mil and Method A for site tests. There shall be no film removed by tape applied to 11 parallel cuts spaced 1/8 inch apart plus 11 similar cuts at right angles.

- e. Impact: ASTM D 2794, no loss of adhesion after direct and reverse impact equal to 1.5 times metal thickness in mils, expressed in inch-pounds.
- f. Humidity Resistance: ASTM D 2247, 2000 hours, no signs of blistering, cracking, creepage or corrosion on score panel.
- g. Abrasion: ASTM D 968, Method A, falling sand shall not expose substrate when tested in quantities 13.2-15.9 gallons of sand per mil of thickness.

2.10.2.1 Interior Liner Panels

Provide both faces of interior liner panels with same finish as the exterior wall panels.

PART 3 EXECUTION

3.1 INSPECTION

Check concrete dimensions, anchor bolt size and placement, and slab elevation with the metal building manufacturer's templates and drawings before setting any steel.

3.2 ERECTION

Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Contracting Officer. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems, including canopy, install closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide a weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

3.2.1 Dissimilar Materials

Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:

- a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.
- b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.
- c. Provide an approved nonabsorptive gasket.
- d. Apply an approved calking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a). Paint green or

wet wood, or wood treated with incompatible wood preservatives, by method (a) or use two coats of aluminum paint.

3.2.2 Rigid Frames, Bases, and Sill Members

Brace frames as necessary to ensure safety. Set accurately, using a nonshrink grout to obtain uniform bearing on the concrete and to maintain a level base line elevation. Clean surfaces to receive the mortar and thoroughly moisten immediately before placement of mortar. Water cure exposed surfaces of mortar with wet burlap for 7 days.

3.2.2.1 Field Welding

Steel, AWS D1.1.

3.2.2.2 Field Bolting

AISC S329

3.2.3 Wall Construction

Apply panels full wall heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Lay side laps away from the prevailing winds. Seal side and end laps with the joint sealing material recommended by the manufacturer. Flash and seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Minimum end laps for all types of panels shall be 2 1/2 inches. Minimum side laps for all types of panels shall be one corrugation, one configuration, or an interlocking joint. Install liner panels on all wall and roof surfaces.

3.2.4 Roof Construction

Apply the roofing panels in full lengths from ridge to eaves and top eave to bottom eave on canopy roof with no transverse joints except at the junction of light transmitting roof panels, vent stacks, and similar openings. Lay side laps away from the prevailing wind, and seal side and end laps with joint sealing material. Flash and seal the roof at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary. Minimum side lap shall be one corrugation or configuration. End laps shall not be less than 6 inches and shall occur only over purlins.

3.2.5 Minimum Fastener Spacing

Space fasteners according to manufacturer's instructions, but not to exceed:

- a. 8 inches o.c. at end laps of covering,
- b. 12 inches o.c. at connection of covering to intermediate supports,
- c. 12 inches o.c. side laps of roof coverings, 18 inches o.c. at side laps of wall.

3.2.6 Installation of Insulation

3.2.6.1 Roof Insulation

Install over purlins before roof liners are applied. Hold insulation rigid until secured in place. Insulation facing shall be placed on the interior

side of the building. Fold and staple facing tabs of insulation on 6-inch centers, from exterior side of building to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets.

3.2.6.2 Wall Insulation

Install over girts before wall coverings are applied. Hold insulation rigid until secured in place. Place facing toward the interior side of the building. Fold and staple facing tabs of insulation on 6-inch centers, from exterior side of building, to completely seal joints. If folding and stapling can only be accomplished from the inside, push the tabs neatly up between the edges of adjoining blankets.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same color and material used for the shop coat. Section 09900, "Paints and Coatings," for painting of all shop-primed ferrous surfaces of the building and all shop-primed surfaces of doors and windows.

3.4 FIELD QUALITY CONTROL

At the discretion of the Contracting Officer, sample panels may be taken at random from each delivery or from stockpiles on the site at any time during the construction period, and tests may be made to check the conformance of the materials to the requirements specified in paragraph entitled "Factory Color Finish." Failure of the sample sheets to pass the required tests shall be cause for rejection of all sheets represented by the samples and replacement of the entire shipment.

-- End of Section --

SECTION 13200

VERTICAL STEEL TANKS

03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install a vertical carbon steel peroxide contact tank, a vertical steel sludge decant tank, and a vertical steel sump tank. These tanks shall be factory assembled and factory coated.

1.2 EQUIPMENT NUMBERS

- a. Peroxide Contact Tank, T-2-1
- b. Sludge Decant Tank, T-10-1
- c. Sump Tank, T-12-1

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-04, Drawings

1.3.1.1 Drawings

- a. Shop drawings that specify the tank dimensions, shell height and plate thickness, type and thickness of roof, type and thickness of bottom plates, materials of construction, foundation requirements, straight shell lengths, nozzle details, dimensions, and locations, and appurtenances. Include details of welded joints. Drawings shall indicate tank pressure ratings. Peroxide contact tank drawings shall indicate conformance with ASME Boiler and Pressure Vessel Code, Section VIII, Division I, Unfired Pressure Vessels. G
- b. Piping arrangement drawing for the sludge decant tank that includes connecting decant and overflow piping and valving, and pipe support locations G
- c. Piping arrangement drawing for the sump tank that includes sump pump connections and influent piping connection, and pipe support locations.
- d. Detail for the level element for the sludge decant tank G
- e. Ladder and railing details for sludge decant tank G

1.3.2 SD-08, Statements

- a. Design Calculations

b. Tank Coatings

1.3.2.1 Design Calculations

Design calculations certified by a Professional Engineer registered in West Virginia including calculations for anchorage of tanks. The calculations shall demonstrate the design stresses in all components of the structure, including accessories.

1.3.2.2 Tank Coatings

Provide tank manufacturer's certification that states factory applied coating system meets or exceeds the requirements specified herein.

1.3.3 SD-19, Operation and Maintenance Manuals

a. Level element, data package 4. G

1.4 QUALITY ASSURANCE

- a. Welding performance qualifications: All welders and welding operators shall be qualified at tank manufacturer's expense by an approved testing laboratory before performing any welding. Qualification tests shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Records of operator and procedure qualifications shall be maintained by the tank manufacturer and shall be made available to the NTR upon request.
- b. Shell joints shall be welded butt joints with complete penetration for the full length of the weld and shall be free from undercuts, overlaps, and abrupt ridges. Weld splatter shall be removed by grinding before application of paint. Flame cut edges shall be ground smooth. No lap joints on the tank shell shall be used.
- c. Unless otherwise stated, continuous seal welds shall be used on all interior and exterior roof and floor plate lap joints, and all other welds, to preclude moisture penetrating between layers of steel. Grind all welds smooth prior to coating.
- d. Tank components shall be carefully fitted to form joints that are free of voids. Voids filled with weld metal are not acceptable.
- e. No welding is permitted on tanks after the interior coatings are applied.

1.5 STANDARD PRODUCTS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the fabrication of ASME pressure rated vessels and steel vessels and shall essentially duplicate equipment that has been in satisfactory operation in similar applications since January 1992.

1.6 DELIVERY

During shipment tanks shall be braced and protected from any distortion or damage. Any such distortion or damage shall be the basis for rejection of the equipment at the NTR's discretion. If special shipping and handling precautions are required, prominently and legibly stencil such precautions on outside of equipment or its crating.

1.7 STORAGE AND HANDLING

Inspect tanks and materials delivered to the site for damage; unload and store with minimum handling. Store tanks and materials on site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Materials shall be protected to the satisfaction of the NTR. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store tanks or materials directly on the ground.

PART 2 PRODUCTS

2.1 PEROXIDE CONTACT TANK

- a. Provide a vertical, cylindrical, welded carbon steel pressure vessel meeting the following requirements:
 1. Diameter: 7 feet
 2. Side Shell Height: 8 feet
 3. Minimum Clear Space Beneath Tank Bottom: 2.5 feet
 4. Top and Bottom Terminations: 2:1 elliptical heads
 5. Design Pressure Rating: 100 psig

Tank shall bear the ASME code stamp certifying the pressure rating.

2.1.1 Tank Design

- a. The peroxide storage tank shall be designed, fabricated, and inspected in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Unfired Pressure Vessels, and the latest addenda thereto. The tank shall be shop fabricated and tested. No welding of the tank will be permitted in the field.
- b. The tank manufacturer shall be responsible for the design of the steel tank based on the requirements in these specifications.
- c. A corrosion allowance of 1/8-inch shall be used.
- d. Welded joints shall be inspected by radiographic testing. The radiographic film shall become the property of the Navy.
- e. Seismic design of the tank shall be in accordance with AWWA D100, Section 13 and portions of AWWA D110-86, Appendix A, and the BOCA National Building Code, 1990 edition for Zone 2.
- f. The minimum thickness of the steel plate for shell and roof on the tank shall be 1/4-inch. All wallplates shall be shaped and bent in the shop to exact radius required. Field bending shall not be permitted.
- g. Factory Fabrication: Metal design and fabrication shall conform with applicable AISC codes of standard practice. Plates and shapes shall be sheared, sawn, or machined true to the dimensions shown. Joining of parts shall be by welding unless other construction is shown. Grind to a smooth, uniform radius all

exposed and rough edges.

2.1.2 Accessories

- a. Provide two manways. Provide one manway on the top elliptical head and one manway 90 degrees from the inlet header with center located 3-feet from the bottom elliptical head. Manways shall have a minimum clear opening of 24-inches unless otherwise noted. Furnish a flanged and bolted type cover with confined gasket for the manway on the top head. Furnish a cam locked type cover rated at 135 psi with a confined neoprene gasket for the manway on the side shell. Hinge covers to tank shell. Grind welds and sheared edges smooth. Provide Type 316 stainless steel bolts and nuts.
- b. Provide 150-pound flanged pipe connections. For each of the nozzles listed below, provide pipe supports welded to the tank for supporting the corresponding vertical pipe.
- c. Gaskets: Tank manufacturer shall supply two sets (one spare) of full face gaskets for all flanged nozzles and manways.
- d. Identification Plates: A 16-gauge type 316 stainless steel identification plate shall be securely mounted on the tank in a readily visible location. The plate shall contain the following:
 1. Equipment tag number.
 2. Tank capacity.
 3. Material specification.
 4. Manufacturer (include address).
 5. Date of manufacture.
- e. Provide four lifting lugs on the tank.
- f. Bolts, anchor bolts, and hex nuts shall be 316 stainless steel.

2.1.3 Nozzles and Appurtenances

- a. Provide a pressure release valve (PRV) on the top of the tank set at 80 percent of the tank's ASME stamped pressure rating. Provide connecting PVC piping to the 2-inch PRV to the nearest floor drain.
- b. Provide one air release valve on top of tank to vent entrained air from the tank.
- c. Provide 4-inch flanged inlet and outlet nozzles. The inlet nozzle shall be located in the center of the top elliptical head. The outlet nozzle shall be located in the center of the bottom elliptical head. Flanges shall comply with AWWA C207-94, Class K ring or hub type, unless otherwise shown. Include 1/8-inch thick gaskets with each flange that are continuous, one-piece, cloth-inserted rubber, ring type to match flanges.

2.2 SLUDGE DECANT TANK

- a. Provide a vertical, cylindrical, cone-bottom, welded carbon steel

tank meeting the following requirements:

1. Diameter: 11.5 feet
2. Side Shell Height: 12 feet
3. Cone Bottom Angle: 30 degrees
4. Depth of Conical Section: 3.3 feet
5. Clear Space Beneath Tank Bottom, excluding nozzle: 2.5 feet
6. Top Termination: 2:1 elliptical head
7. Total Tank Height: 17.8 feet (excluding height produced by elliptical head)
8. Capacity: 10,000 gallons

2.2.1 Tank Design

- a. The tank shall be of welded steel construction. Tank shall be supported by four support legs.
- b. The sludge decant tank shall be designed, fabricated, and inspected in accordance with AWWA D100. The tank roof shall be designed and fabricated in accordance with API-650-84. The tank shall be shop fabricated and tested. No welding of the tank will be permitted in the field.
- c. The tank manufacturer shall be responsible for the design of the steel tank based on the requirements in these specifications.
- d. A corrosion allowance of 1/8-inch shall be used.
- e. Welded joints shall be inspected by radiographic testing. The radiographic film shall become the property of the Navy.
- f. Seismic design of the tank shall be in accordance with AWWA D100, Section 13 and portions of AWWA D110-86, Appendix A, and the BOCA National Building Code, 1990 edition for Zone 2.
- g. The minimum thickness of the steel plate for shell and roof on the tank shall be 1/4-inch. All wallplates shall be shaped and bent in the shop to exact radius required. Field bending shall not be permitted.
- h. Factory Fabrication: Metal design and fabrication shall conform with applicable AISC codes of standard practice. Plates and shapes shall be sheared, sawn, or machined true to the dimensions shown. Joining of parts shall be by welding unless other construction is shown. Grind to a smooth, uniform radius all exposed and rough edges.
- i. Tank shall be designed to withstand the forces imposed by a top-entering mixer. Preliminary mixer static weight is 1,256 pounds, weight moment is 1,008 lb-inches, dynamic torque is 13,903 lb-inches, bending moment is 22,880 lb-inches, and dynamic shear is 200 pounds. Contractor shall verify mixer design loads and adjust requirements according to final mixer design loads.

2.2.2 Accessories

- a. Provide two manways. Manways shall have a 24-inch diameter clear opening. Provide one manway on the side shell located 90 degrees

from the overflow nozzle, the manway centerline located 3 feet from the top of the cone bottom. Furnish cam locked type cover rated at 135 psi with confined neoprene gasket. Hinge cover to tank shell. Provide one manway on the top of the tank. Furnish flanged and bolted type cover with confined gasket. Hinge cover to tank shell. Grind welds and sheared edges smooth. Provide Type 316 stainless steel bolts and nuts.

- b. Provide 150-pound flanged pipe connections. For each of the nozzles listed below, provide pipe supports welded to the tank for supporting the corresponding vertical pipe.
- c. Gaskets: Tank manufacturer shall supply two sets (one spare) of full face gaskets for all flanged nozzles and manways.
- d. Identification Plates: A 16-gauge type 316 stainless steel identification plate shall be securely mounted on the tank in a readily visible location. The plate shall contain the following:
 - 1. Equipment tag number.
 - 2. Tank capacity.
 - 3. Material specification.
 - 4. Manufacturer (include address).
 - 5. Date of manufacture.
- e. Provide four lifting lugs on the tank.
- f. Bolts, anchor bolts, and hex nuts shall be 316 stainless steel.
- g. Outside Tank Ladder: Provide sludge decant tank with an 18-inch wide exterior steel ladder. Ladder shall be securely attached to the tank. Ladder rungs shall be spaced one foot apart. Ladder handrail shall extend to 42 inches above the top of the tank.
- h. Handrail: Provide handrail around the top of the sludge decant tank. Handrails shall be 1-1/2-inch, Schedule 40 clear anodized aluminum pipe with toeboards. Handrail shall consist of a 2-rail system designed for concentrated load of 300 pounds or a uniform horizontal load of 50 pounds per lineal foot with a simultaneous vertical downward load of 100 pounds on the top rail. Post spacing shall be no greater than 5 feet. Mount handrails using stainless steel side mounted brackets and fasteners. Handrails shall be fabricated in accordance with applicable OSHA and BOCA requirements.
- i. Baffles: Provide vertical baffles on the tank interior to aid in mixing operations. Baffles shall be steel and shall be welded to the tank wall and reinforced to withstand the forces developed during operation of the tank mixer. Provide four (4) equally spaced vertical baffles on the tank side shell. Each baffle shall be 11 inches wide, and shall extend to within one foot of the top and 3 inches of the bottom of the straight side.

2.2.3 Nozzles and Appurtenances

- a. Provide the following nozzles and appurtenances on the top of the tank:
 1. One 6-inch nozzle with 6-inch PVC piping for tank venting to outside the building.
 2. One 6-inch nozzle for dirty backwash water inlet piping.
 3. One 28-inch nozzle in the center of the elliptical head for insertion of the top-entering mixer. Mixer requirements are specified in Section 11370, "Top-Entering Mixer." Mixer nozzle diameter must be coordinated with the requirements of the mixer.
 4. One 1-inch nozzle for dewatering aid inlet piping.
 5. One 3-inch nozzle for the ultrasonic level element (LE 10-1). The level element shall be used to sense water level in the tank. A level transmitter (LE 10-1) shall transmit the level signal to the Main Control Panel. LOW LEVEL, HIGH LEVEL, AND HIGH-HIGH LEVEL setpoints are described in Section 13000, "Instrumentation Components."
- b. Provide the following nozzles and appurtenances on the straight side shell of the dewatering tank:
 1. Four 2-inch nozzles for decant water draw off. See Drawings for an illustration of the piping connections for these nozzles. The nozzles shall be spaced at 2-foot intervals starting at 1-foot above the top of the cone bottom of the tank.
 2. One 4-inch nozzle for overflow. The nozzle centerline shall be located 0.5 feet below the top of the straight side shell.
 3. One 2-inch nozzle for core blow inlet piping. The nozzle centerline shall be located 1 foot below the top of the straight side shell.
- c. Provide the following nozzles and appurtenances on the bottom of the tank:
 1. One 4-inch nozzle on the center of the cone bottom for sludge discharge and transfer to the filter press.

2.3 SUMP TANK

- a. Provide a vertical, square, flat-bottom, welded carbon steel tank meeting the following requirements:
 1. Width and Depth: 5 feet by 5 feet
 2. Side Shell Height: 5.5 feet
 3. Clear Space Beneath Tank Bottom 0.5 feet
 6. Top Termination: flat head
 7. Total Tank Height: 6 feet
 8. Capacity: 1,000 gallons

2.3.1 Tank Design

- a. The tank shall be of welded steel construction. Tank shall be

supported by four support legs.

- b. The sump tank shall be designed, fabricated, and inspected in accordance with AWWA D100. The tank shall be shop fabricated and tested. No welding of the tank will be permitted in the field.
- c. The tank manufacturer shall be responsible for the design of the steel tank based on the requirements in these specifications.
- d. A corrosion allowance of 1/8-inch shall be used.
- e. Welded joints shall be inspected by radiographic testing. The radiographic film shall become the property of the Navy.
- f. Seismic design of the tank shall be in accordance with AWWA D100, Section 13 and portions of AWWA D110-86, Appendix A, and the BOCA National Building Code, 1990 edition for Zone 2.
- g. The minimum thickness of the steel plate for shell and roof on the tank shall be 1/4-inch. All wallplates shall be shaped and bent in the shop to exact radius required. Field bending shall not be permitted.
- h. Factory Fabrication: Metal design and fabrication shall conform with applicable AISC codes of standard practice. Plates and shapes shall be sheared, sawn, or machined true to the dimensions shown. Joining of parts shall be by welding unless other construction is shown. Grind to a smooth, uniform radius all exposed and rough edges.
- i. Tank shall be designed to withstand the forces imposed by a vertical sump pump. Contractor shall determine pump design loads and adjust requirements according to final mixer design loads.

2.3.2 Accessories

- a. Provide one manway on the tank top. Manway shall have an 18-inch diameter clear opening. Furnish flanged and bolted type cover with confined gasket. Hinge cover to tank shell. Grind welds and sheared edges smooth. Provide Type 316 stainless steel bolts and nuts.
- b. Provide 150-pound flanged pipe connections.
- c. Gaskets: Tank manufacturer shall supply two sets (one spare) of full face gaskets for all flanged nozzles and manways.
- d. Identification Plates: A 16-gauge type 316 stainless steel identification plate shall be securely mounted on the tank top. The plate shall contain the following:
 - 1. Equipment tag number.
 - 2. Tank capacity.
 - 3. Material specification.
 - 4. Manufacturer (include address).

5. Date of manufacture.

e. Provide four lifting lugs on the tank.

f. Bolts, anchor bolts, and hex nuts shall be 316 stainless steel.

2.3.3 Nozzles and Appurtenances

a. Provide the following nozzles and appurtenances on the tank:

1. One 4-inch nozzle with 4-inch PVC piping for tank venting to outside the building.

2. One 6-inch nozzle for building floor trench inlet piping.

3. Two nozzles in the top of the tank for insertion of the vertical sump pumps, sized by Contractor after final selection of the vertical sump pumps.

4. Two nozzles in the top of the tank for sump pump effluent piping, sized by Contractor after final selection of the vertical sump pumps.

5. One nozzle in the top of tank for float element controls. Contractor shall select location and size after final pump selection.

2.4 COATING SYSTEM

2.4.1 Surface Preparation

2.4.1.1 Preblast Cleaning Requirements

a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.

c. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.

d. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

e. Welds and Adjacent Areas:

1. Prepare such that there is:

- No undercutting or reverse ridges on weld bead.

- No weld spatter on or adjacent to weld or other area to be painted.

- No sharp peaks or ridges along weld bead.

2. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

2.4.1.2 Blast Cleaning Requirements

- a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
- b. Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.
- c. Use only dry blast cleaning methods.
- d. Do not reuse abrasive, except for designed recyclable systems.
- e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.

2.4.1.3 Post-Blast Cleaning and Other Cleaning Requirements

- a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
- b. Paint surfaces the same day they are blast cleaned. Reblast surfaces that have started to rust before they are coated.

2.4.2 Application

2.4.2.1 General

- a. The intention of these Specifications is for new, interior and exterior metal and submerged metal surfaces to be painted, whether specifically mentioned or not, except as modified herein. Prime coat structural steel surfaces.
- b. Extent of Coating (Immersion): Coatings shall be applied to all internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
- c. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
- d. Apply coatings in accordance with paint manufacturer's recommendations. Allow sufficient time between coats to assure thorough drying of previously applied paint.
- e. Paint units to be bolted together and to structures prior to assembly or installation.
- f. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

2.4.2.2 Shop Primed Surfaces

- a. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
- b. For two-package or converted coatings, consult coatings manufacturer for specific procedures as relates to manufacturer's products.
- c. Prior to application of finish coats, clean shop primed surfaces free of dirt, oil, and grease and apply mist coat of specified primer, 1-mil dry film thickness.
- d. After welding, prepare and prime holdback areas as required for specified paint system. Apply primer in accordance with manufacturer's instructions.

2.4.2.3 Stripe Coating

- a. Stripe coat all field welds, edges, angles, fasteners, and other irregular surfaces located inside tanks.
- b. Stripe coat shall consist of one coat, brush applied, to the coating thickness specified.
- c. Apply stripe coat between intermediate and final coats.

2.4.2.4 Film Thickness

- a. Number of Coats: Minimum required without regard to coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
- b. Maximum film build per coat shall not exceed coating manufacturer's recommendations.
- c. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 1. Perform with properly calibrated instruments.
 2. Recoat and repair as necessary for compliance with the Specifications.
 3. All coats are subject to inspection by NTR and coating manufacturer's representative.
- d. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
- e. Thickness Testing:
 1. After repaired and recoated areas have dried sufficiently, final tests will be conducted by the NTR.

2. Measure coating thickness specified in mils with a magnetic type dry film thickness gauge.
3. Test finish coat for holidays and discontinuities with an electrical holiday detector, low voltage, wet sponge type.
4. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

2.4.2.5 Damaged Coatings, Pinholes, and Holidays

- a. Feather edges and repair in accordance with recommendations of paint manufacturer.
- b. Apply finish coats, including touchup and damage-repair coats in a manner which will present a uniform texture and color-matched appearance.

2.4.2.6 Unsatisfactory Application

- a. If item has an improper finish color, or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
- b. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
- c. Evidence of runs, bridges, shiners, laps, or other imperfections are causes for rejection.
- d. Repair defects in coating systems in accordance with written recommendations of coating manufacturer.
- e. Leave all staging up until NTR has inspected surface or coating. Replace staging removed prior to approval by NTR.

2.4.3 Protective Coatings Systems

2.4.3.1 Submerged Metal-Potable Water for Interior of Tanks

<u>Surface Prep</u>	<u>Paint Material</u>	<u>Min. Coats, Cover</u>
Abrasive Blast	Potable grade, polyamide epoxy coating	3 coats, 3 MDFTPC

a. Application Schedule:

1. Use this system on all metal surfaces inside tanks, including, but not limited to, steelplates and structural steel; interior and exterior surfaces of the inlet, outlet, and overflow piping; manhole covers; hatches; ladders; landings; couplings; and vents.
2. Coating is not required for the bottom side of the floor plates.

3. Provide full coating thickness to the top of all structural steel that will be covered by the roof plates, or otherwise shielded from full coating thickness, before the structural steel members are installed. Remove coating in areas to be welded.

2.4.3.2 Exposed Metal-Atmospheric for Exterior of Tanks

<u>Surface Prep</u>	<u>Paint Material</u>	<u>Min. Coats, Cover</u>
Abrasive Blast, or Centrifugal Wheel Blast (SP 6-91)	Rust-inhibitive primer	1 coat, 2 MDFT
	Alkyd enamel	2 coats, 4 MDFT

a. Application Schedule: Use this system on exposed exterior metal surfaces of tanks. For galvanized surfaces to be coated, reference System No. 10.

b. Tank Coating Sequence Anticipated:

1. Shop prime all surfaces of shell plates and roof and floor plates and structural steel associated with the exterior of the tank; hold back shop primer where required for field welding.
2. Shop priming of galvanized steel surfaces is not required.
3. After tank erection, abrasive blast welds (SP 10-91) and damaged areas; apply primer.
4. Clean primed surfaces and brush blast.
5. Apply mist coat of primer.
6. Apply finish coats.
7. Touch up as required.

2.5 SERVICE CONDITIONS

a. The peroxide contact tank shall be designed for operating pressures up to 100 psig. It will contain groundwater contaminated with low concentrations of heavy metals and VOCs. Peroxide will be injected into the process line prior to the contact tank. The tank shall be designed to handle material with the following characteristics:

Specific gravity: 1.0
pH: 6 to 10
Temperature: 40 to 100 degrees F

b. The sludge storage tank shall be used contain the backwash water from the pressure filter and to settle out the solids prior to dewatering with a filter press. The tank shall be designed to handle material with the following characteristics:

Specific gravity: 1.1
pH: 6 to 10
Temperature: 40 to 100 degrees F

2.6 FACTORY TESTING

The tanks shall be tested for leaks under the proposed operating conditions to ensure the equipment components are free from cracks and other imperfections. All such leaks and imperfections shall be corrected and the unit shall be retested. Certified test results shall be submitted to the NTR prior to tank shipment to the site.

PART 3 EXECUTION

3.1 PREPARATION

Prior to installation, the Contractor shall construct concrete support pads for each of the tanks as shown on the Drawings.

3.2 INSTALLATION OF FITTINGS AND ACCESSORIES

The Supplier shall provide all fittings and accessories required for the complete tank systems.

3.3 MOUNTING AND INSTALLATION

- a. Mounting on tank foundation shall be such that there is an even distribution of the equipment weight and when fully loaded there will be no distortion or unequal stresses upon the equipment.
- b. Install connecting piping as indicated in this Specification and as shown on the Drawings.
- c. Tanks shall be anchored per the requirements of the Drawings and Specifications.

3.4 TESTING OF INSTALLED EQUIPMENT

- a. Inspection and testing of all tanks shall be performed at the project site in the presence of the NTR, and certification shall be submitted to the NTR indicating the test procedure used and results of the test. All tanks shall be hydrostatically tested. The peroxide contact tank shall be hydrostatically tested at a pressure of 100 psig for a period of one hour and inspected for leaks and structural fatigue. The sludge decant tank shall be filled with water for a period of six hours at atmospheric pressure and inspected for leaks and structural failure.
- b. Prior to plant startup, all equipment shall be inspected for proper alignment, connection, and function and to verify complete compliance with the Drawings and Specifications.

-- End of Section --

SECTION 13209

WATER STORAGE TANKS
09/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1994) Pipe, Steel, Black and Hot-Dipped,
Zinc-Coated Welded and Seamless

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (1992) Hypochlorites

AWWA B301 (1992) Liquid Chlorine

AWWA C115/A21.15 (1988) Flanged Ductile-Iron Pipe with
Threaded Flanges

AWWA C205 (1989) Cement-Mortar Protective Lining and
Coating for Steel Water Pipe 4in and
Larger - Shop Applied

AWWA C500 (1993) Metal-Seated Gate Valves for Water
Supply Service

AWWA C508 (1993) Swing-Check Valves for Waterworks
Service, 2 in. (50 mm) Through 24 in. (600
mm) NPS

AWWA C600 (1993) Installation of Ductile-Iron Water
Mains and Their Appurtenances

AWWA C652 (1992) Disinfection of Water-Storage
Facilities

AWWA D100 (1984; Addendum 1989) Welded Steel Tanks
for Water Storage

AWWA D101 (1953; R 1986) Inspecting and Repairing
Steel Water Tanks, Standpipes, Reservoirs,
and Elevated Tanks, for Water Storage

AWWA D103 (1987) Factory-Coated Bolted Steel Tanks
for Water Storage

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910-SUBPART Z

Toxic and Hazardous Substances

29 CFR 1910.27

Fixed Ladders

MILITARY SPECIFICATIONS (MIL)

MIL-B-131	(Rev. H; Int Am. 1) Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-Sealable
MIL-P-3420	(Rev. F) Packaging Materials, Volatile Corrosion Inhibitor Treated, Opaque
MIL-A-22262	(Rev. B; Am. 1) Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-P-28578	(Rev. B) Paint, Water-Borne, Acrylic or Modified Acrylic, Semigloss, for Metal Surfaces

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
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NSF INTERNATIONAL (NSF)

NSF 61	(1995) Drinking Water System Components - Health Effects
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STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC SP 5	(1991) White Metal Blast Cleaning
SSPC SP 10	(1991) Near-White Blast Cleaning
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting

1.2 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Tanks including accessories and components
- b. Coating systems for welded tanks

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

Include detail specifications, available performance test data, and instructions for installation and maintenance.

1.2.2 SD-04, Drawings

- a. Foundations
- b. Obstruction lighting
- c. Elevated steel tank
- d. Grounding systems

Submit shop drawings for approval. Indicate types, sizes, locations, plate thicknesses, installation details, and other construction details. Provide design calculations for lateral forces.

1.2.3 SD-06, Instructions

- a. Coating systems for welded tanks

Before application of coating systems, submit printed instructions which include brand names, catalog numbers, detailed mixing and application procedures, number and types of coats required, minimum and maximum application temperatures, and curing procedures.

1.2.4 SD-08, Statements

- a. AWWA D100
- b. AWWA D103
- c. SSPC SP 5
- d. SSPC SP 10
- e. SSPC VIS 1

1.2.5 SD-10, Test Reports

- a. Mill test on steel tank plates
- b. Mill test on structural steel
- c. Abrasive for blasting

Test reports shall include sieve analysis, mohs hardness, free silica, moisture, chloride, arsenic, beryllium, cadmium, chromium, fluorine, lead, mercury, and radioactive materials.

1.2.6 SD-19, Operation and Maintenance Manuals

- a. Water storage tank, Data Package 1

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.3 DELIVERY AND STORAGE

Handle and store water storage tank systems, components, and parts to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling. Deliver paint in unopened containers with unbroken seals and labels showing designated name, specification number, color, directions for use, manufacturer, and date of manufacture, legible and intact at time of use.

1.4 ENVIRONMENTAL CONDITIONS

Apply paint under dry and dust free conditions. Unless otherwise approved, do not apply paint when temperature falls below 40 degrees F or rises above 90 degrees F.

PART 2 PRODUCTS

2.1 EQUIPMENT

Elevated steel tank with a minimum storage capacity of 75,000 gallons. High water level at elevation 826.00, and top of foundation(s) at elevation 670.00. Existing grade at tank site shall be as indicated. Freeze protection shall consist of heat tracing and insulation on 8-inch riser pipe. **REQUIREMENTS FOR HEAT TRACE AND INSULATION PROVIDED IN SECTION "16402" INTERIOR DISTRIBUTION SYSTEM."**

2.1.1 Elevated Steel Tank

Elevated tank diameter 25 feet, and head range 27 feet. Provide tank with an ellipsoidal or spheroidal bottom with single pedestal type support tower. Alternative designs showing different types of construction may be submitted to Contracting Officer for approval, at option of Contractor.

2.2 MATERIALS

2.2.1 Tanks

AWWA D100 for welded tanks.

2.2.2 Pipe and Fittings

2.2.2.1 Steel Pipe

ASTM A 53, zinc-coated, Schedule 40. Line interior pipe with cement-mortar in accordance with AWWA C205. Pipe exterior shall be painted to match adjacent surfaces. Refer to Section 09900, "Paints and Coatings."

2.2.2.2 Insulating Joints

Design insulating joints to effectively prevent metal-to-metal contact at joint between adjacent sections of piping of dissimilar metals. Joint shall be of flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and as recommended in the Appendix to AWWA C115/A21.15. Provide bolts and nuts as recommended in AWWA C115/A21.15.

2.2.3 Valves

2.2.3.1 Gate Valves

AWWA C500, iron-body, bronze-mounted, non-rising stem, for minimum working pressure of 150 pounds per square inch, flanged ends, clear waterway equal to full nominal diameter, hand wheel operated, and open by turning counterclockwise.

2.2.3.2 Check Valves

AWWA C508, horizontal swing check valve, flanged ends, and composition to metal seat.

2.2.3.3 Valves, 2 Inches and Smaller in Size

MSS SP-80, gate valve, Type 1, 2, 3 or 4, Class 125.

2.2.4 Coating Systems for Welded Tanks

2.2.4.1 Interior

Commercially available Polyamide Epoxy system that is NSF 61 certified for use in potable water storage vessels of the capacity required. System consists of three coats, 4-6 mils dry film thickness (DFT) per coat, for total of 12-18 mils min.

2.2.4.2 Exterior

A system consisting of one coat of Navy Formula 150, green primer MIL-P-24441/1 applied at 3-mils minimum dry film thickness; one intermediate coat of Navy Formula 151, haze gray MIL-P-24441/2 applied at 3 mils minimum thickness; and one top coat of MIL-P-28578 color number 16440 light gray.

2.2.5 Concrete Work

Provide as specified in Section 03300, "Cast-In-Place Concrete."

2.2.6 Chlorine

AWWA B300 for hypochlorites or AWWA B301 for liquid chlorine, mixed with water to give the solutions required in AWWA C652.

2.2.7 Vapor-Tight Material

MIL-B-131 or MIL-P-3420.

2.2.8 Abrasive for Blasting

Sharp, washed, salt-free, angular, crushed wet bottom boiler slag, free from feldspar or other constituents that tend to break down and remain on surface. Abrasive shall conform to MIL-A-22262, Class 2, low free silica except that free silica content shall not exceed one percent and Mohr hardness shall be 7 to 9, Medium grade.

2.2.8.1 Gross Gamma Radioactivity Concentration

Not to exceed 5.0 picocuries per gram.

2.2.8.2 Toxic Substances

Interpret MIL-A-22262 to include the meaning that abrasive material contains a maximum one percent by weight of any toxic substance listed in either Table Z-1, Z-2, or Z-3 or OSHA 29 CFR 1910-SUBPART Z, with the exception of inert or nuisance dust materials, arsenic, beryllium, cadmium, cobalt, lead, mercury, rhodium, silver, tellurium, thallium, and uranium.

2.3 CATHODIC PROTECTION

Provide cathodic protection in accordance with Section 13112, "Cathodic Protection System (Steel Water Tanks)."

2.4 OBSTRUCTION LIGHTING

Install obstruction lights as indicated. Place wiring in rigid conduit and threaded conduit fittings. Control obstruction lighting by a time switch enclosed in a cast metal weatherproof housing located approximately 6 feet above the ground on water tank. Perform electrical work in accordance with NFPA 70.

2.5 GROUNDING SYSTEM

The tank vendor shall design and install a grounding system for the elevated storage tank. Grounding system shall comply with NFPA 70 and ANSI C2, and the requirements of Section 16303, "Underground Electrical Work."

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Welded Storage Tank

Install in accordance with applicable requirements of AWWA D100. Applicable requirements set forth by the following designated sections thereof shall govern, unless otherwise specified:

- a. Materials: Section 2.
- b. General Design: Section 3. Design for wind velocity of 100 mph. Earthquake resistance required, using design percentages for zone 0 using Section 13.
- c. Sizing and Design: Elevated steel tank, Section 4.
- d. Welding: Section 8.
- e. Shop Fabrication: Section 9.
- f. Erection: Section 10.
- g. Inspection and Testing: Section 11.
- h. Accessories for Steel Elevated Water Tank: Section 5 with the following additions or modified requirements: Safety devices; screened vent; pipe connection 8 inches in diameter. Overflow shall be 6 inches in diameter and oriented as shown on the Drawings.

3.1.1.1 Foundations

Construct in accordance with AWWA D100 and as specified herein. The details and configuration indicated for the water storage tank and foundation are illustrative of the general requirements. A complete foundation design, including calculations prepared by a registered engineer, shall be submitted for approval. The Contractor shall verify that the indicated foundation design is applicable for the submitted tank. All costs associated with the design and construction of modified tanks and foundations shall be at the expense of the Contractor.

3.1.2 Fixed Ladders

29 CFR 1910.27. Install ladder safety devices for ladders over 20 feet in unbroken length.

3.2 PIPING SYSTEM TEST

After tank erection and installation of valves and piping, and prior to field painting, test exterior piping in accordance with applicable requirements of AWWA C600. Replace defective material disclosed by pressure test and repeat test until results are satisfactory.

3.3 PAINTING OF WELDED TANKS

3.3.1 Shop Painting

As soon after fabrication as practicable, shop prime steel surfaces, except seam surfaces of tank plates. Immediately prior to priming, clean surfaces thoroughly by abrasive blasting with grit or sand conforming to MIL-A-22262, to remove rust, fillings, blister, mill scale, dirt, oil, grease, and other foreign matter. Apply shop primer material recommended by coating system supplier as having extended compatibility with primer of specified coating system.

3.3.2 Field Painting

After tank has been erected and leak tested, apply paint to interior and exterior of tank. Give edges, corners, crevices, and joints special attention to ensure that surfaces are clean and ground smooth, and receive an adequate thickness of paint. Follow mixing and application instructions. Allow a minimum of two hours drying time between coats. Paint entire structure as described below:

3.3.2.1 Interior

Repair damaged areas of shop primer by abrasive blasting in accordance with SSPC SP 5 and SSPC VIS 1. Remove hazardous blasting residue in accordance with Section 01575, "Temporary Environmental Controls." On the same day as blasting, apply the primer coat of specified coating system.

- a. Interior Surface Preparation: Abrasive-blast interior surfaces of tank and riser to white metal in accordance with SSPC SP 5. Keep test plate carefully wrapped and sealed in vapor-tight material for corrosion protection. Use conventional air, force-feed or pressure blasting equipment. Under no circumstances will any type of water or vapor blast be permitted. Provide nozzle capable of maintaining a pressure of 90 plus or minus 10 psig at the blast generator. Provide filtered air supply free of oil and moisture. When directed by the Contracting Officer, blow compressed air through a clean white cloth to check for oil and moisture.

Perform blasting in sections or blocks small enough to permit application of epoxy coating system during same working shift. Time interval between blasting and application of primer shall not exceed 8 hours. Abrasive-blast surfaces to be coated to match prepared test plates. After abrasive-blasting, thoroughly clean surfaces by brushing and vacuuming. Surfaces to receive coating shall be dry, clean, and free of dust and dirt. When directed by the Contracting Officer, inspect blasted surfaces with black light to check for fluorescence from compressor oil. Surfaces to be painted shall be free of oil. All blast-cleaned surfaces shall have a blast profile depth of 1.5 to 2.0 mils.

- b. Application of Interior Coating System: Apply an interior coating system to entire tank interior and inside of riser. For irregular surfaces, apply primer by brushing material into corners, crevices, welds, and angles. Apply primer coat within 8 hours after blast cleaning. If visible rusting occurs after blasting, regardless of time interval, re-blast rusted surface prior to applying primer. Use experienced applicators. Apply each coat by using either brushing or spraying. Rollers are prohibited. Equip painters with wet film gages to check wet film thickness. Determine ratios of wet film thickness to dry film thickness to attain dry film thickness within required range. Apply coating system in conformance with SSPC PA 1 and manufacturer's printed instructions. Safety precautions shall be rigidly followed. Minimum drying time for each coat shall be 48 hours at 70 degrees F. Ventilation rate shall be a minimum one air change every 4 hours.

3.3.2.2 Exterior

Repair damaged areas of shop primer by abrasive blasting in accordance with SSPC SP 10 and SSPC VIS 1. Remove hazardous blasting residue in accordance with Section 01575, "Temporary Environmental Controls." On same day as blasting, apply primer coat of specified coating system.

Thoroughly clean exterior surfaces not covered by shop coat and abraded surfaces in shop coat with scrapers and wire brushes to expose bright metal, with particular attention given to areas around joints. Immediately following this operation, apply a patch coat of paint specified for shop priming to cleaned and dried surfaces. If shop coat has weathered for more than 9 months, apply a full coat of shop coat primer. Paint piping exterior to tank above ground in same manner as tank.

3.4 INSPECTION AND REPAIR OF STEEL TANKS

Prior to tank repair job, perform a detailed inspection of the structure and submit report by a certified inspector. Inspection and repair of existing steel water tanks, standpipes, reservoirs, and elevated tanks for water storage shall be in accordance with AWWA D101.

3.5 FIELD QUALITY CONTROL

3.5.1 General Inspection

Notify Contracting Officer at the following steps in the work, so that appropriate inspections may be conducted:

Step

Action

After abrasive blasting

Interior surface inspection for appropriate finish for coating application as specified in the paragraph entitled "Application of Interior Coating System," in this section.

During and after coating

Interior coating application inspection as specified in paragraphs entitled "Application of Interior Coating System" and "Final Inspection," in this section

3.5.2 Final Inspection

Following completion and preliminary cure of coating system, inspect surfaces carefully for pinholes, blisters, inadequate coating thickness, and other defects. Repair imperfections found. Measure dry film thickness at 10 equally spaced points within an area as designated. Discard high and low values and take an average of the remaining eight values as coating thickness. If average is less than specified minimum dry film thickness, take additional readings in adjacent areas to define extent of thin area. Re-coat such areas as necessary to achieve specified thickness. Perform pinhole testing by low voltage wet sponge method.

3.5.3 Methyl Ethyl Ketone (MEK) Rub Test

After coating system has been inspected and approved, allow coating to cure for at least 7 days. Check the epoxy coating for completeness of cure using MEK rub test. Saturate a clean cotton swab with MEK. Place saturated cotton swab against the surface to be tested so that solvent wets surface. Hold swab against surface for not less than one minute, then rub wetted surface with swab for 10 seconds. Coating shall be considered completely cured, if there is no sign of softening in coating and there is no discoloration on the cotton swab attributable to coating. If epoxy coating is not completely cured, allow coating to cure another 7 days and repeat MEK rub test. Do not introduce chlorinated water or chlorine disinfectant solution into a tank with incompletely cured epoxy since further curing will be inhibited.

3.6 DISINFECTION

After coating system has been inspected, approved, and cured, rinse tank with potable water. Disinfect tank and connecting lines in accordance with AWWA C652, Method 1, Method 2, or Method 3.

-- End of Section --

SECTION 13281

ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS
12/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z9.2 (1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
- ANSI Z88.2 (1992) Respiratory Protection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM C 732 (1995) Aging Effects of Artificial Weathering on Latex Sealants
- ASTM D 522 (1993; Rev. A) Mandrel Bend Test of Attached Organic Coatings
- ASTM D 1331 (1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
- ASTM D 2794 (1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- ASTM E 84 (1995; Rev. B) Surface Burning Characteristics of Building Materials
- ASTM E 96 (1995) Water Vapor Transmission of Materials
- ASTM E 119 (1995; Rev. A) Fire Tests of Building Construction and Materials
- ASTM E 736 (1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
- ASTM E 1368 (1990) Visual Inspection of Asbestos Abatement Projects

CODE OF FEDERAL REGULATIONS (CFR)

- 29 CFR 1926.103 Respiratory Protection
- 29 CFR 1926.51 Sanitation

29 CFR 1926.200	Accident Prevention Signs and Tags
29 CFR 1926.59	Hazard Communication
29 CFR 1926.1101	Asbestos, Tremolite, Anthophyllite, Actinolite
40 CFR 61-SUBPART A	General Provisions
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos Containing Material in Schools

NAVY DIRECTIVES (ND)

ND OPNAVINST 5100.23	(Rev. D) Navy Occupational Safety and Health (NAVOSH) Program Manual
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UNDERWRITERS LABORATORIES INC. (UL)

UL 586	(1990) High-Efficiency, Particulate, Air Filter Units
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1.2 DEFINITIONS

1.2.1 ACM

Asbestos Containing Materials.

1.2.2 Amended Water

Water containing a wetting agent or surfactant with a maximum surface tension of 29 dynes per centimeter when tested in accordance with ASTM D 1331.

1.2.3 Area Sampling

Sampling of asbestos fiber concentrations which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.2.4 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos and any of these minerals that has been chemically treated or altered. Materials are considered to contain asbestos if the asbestos content of the material is determined to be at least one percent.

1.2.5 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris.

1.2.6 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and

Health (NIOSH) Method 7400.

1.2.7 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average measured in the breathing zone as defined by 29 CFR 1926.1101 or other Federal legislation having legal jurisdiction for the protection of workers health.

1.2.8 Background

The ambient airborne asbestos concentration in an uncontaminated area as measured prior to any asbestos hazard abatement efforts. Background concentrations for other (contaminated) areas are measured in similar but asbestos free locations.

1.2.9 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

1.2.10 Encapsulation

The abatement of an asbestos hazard through the appropriate use of chemical encapsulants.

1.2.11 Encapsulants

Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

- a. Removal Encapsulant (can be used as a wetting agent)
- b. Bridging Encapsulant (used to provide a tough, durable surface coating to asbestos containing material)
- c. Penetrating Encapsulant (used to penetrate the asbestos containing material encapsulating all asbestos fibers and preventing fiber release due to routine mechanical damage)
- d. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).

1.2.12 Friable Asbestos Material

One percent asbestos containing material that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.2.13 Glovebag Technique

Those asbestos removal and control techniques put forth in 29 CFR 1926.1101 Appendix G.

1.2.14 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust

ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.2.15 Navy Consultant (NC)

That qualified person employed directly by the Government to monitor, sample, inspect the work or in some other way advise the Contracting Officer. The NC is normally a private consultant, but can be an employee of the Government.

1.2.16 Negative Pressure Enclosure (NPE)

That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.

1.2.17 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, removal, or mishap.

1.2.18 Personal Sampling

Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.

1.2.19 Private Qualified Person (PQP)

That qualified person hired by the Contractor to perform the herein listed tasks.

1.2.20 Qualified Person (QP)

A Registered Architect, Professional Engineer, Certified Industrial Hygienist, consultant or other qualified person who has successfully completed training and is therefore accredited under a legitimate State Model Accreditation Plan as described in 40 CFR 763 as a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer; and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The QP must be qualified to perform visual inspections as indicated in ASTM E 1368. The QP shall be appropriately licensed in the State of West Virginia.

1.2.21 TEM

Refers to Transmission Electron Microscopy.

1.2.22 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.

1.2.23 Wetting Agent

A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 29 dynes per centimeter when tested in accordance with ASTM D 1331.

1.3 REQUIREMENTS

1.3.1 Description of Work

The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures shall be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The asbestos work includes the demolition and removal of 260 linear feet of 8-inch transite pipe located in the vicinity of Building 344 and the new treatment building which is governed by 40 CFR 763. Under normal conditions non-friable or chemically bound materials containing asbestos would not be considered hazardous; however, this material may release airborne asbestos fibers during demolition and removal and therefore must be handled in accordance with the removal and disposal procedures as specified herein. Provide removal techniques as outlined in this specification. The Navy will evacuate the work area during the asbestos abatement work.

1.3.2 Medical Requirements

Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.

1.3.2.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract.

The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.3.2.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 50 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

1.3.3 Training

Train all personnel involved in the asbestos control work in accordance

with United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. The Contractor shall document the training by providing: dates of training, training entity, course outline, names of instructors, and qualifications of instructors upon request by the Contracting Officer. Furnish each employee with respirator training and fit testing administered by the PQP as required by 29 CFR 1926.1101. Fully cover engineering and other hazard control techniques and procedures.

1.3.4 Permits and Notifications

Obtain necessary permits in conjunction with asbestos removal, encapsulation, hauling, and disposition, and furnish notification of such actions required by Federal, State, regional, and local authorities prior to the start of work. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M.

1.3.5 Environment, Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61-SUBPART A, 40 CFR 61-SUBPART M, and ND OPNAVINST 5100.23. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Government shall apply. The following laws, ordinances, criteria, rules and regulations regarding removal, handling, storing, transporting and disposing of asbestos materials apply:

- a. West Virginia Code of State Rules, Environmental Regulations, Title 64 Procedural Rules for the Department of Health, Series 63 Asbestos Abatement Licensing Rule.

1.3.6 Respiratory Protection Program

Establish and implement a respirator program as required by ANSI Z88.2, 29 CFR 1926.1101, and 29 CFR 1926.103. Submit a written description of the program to the Contracting Officer.

1.3.7 Asbestos Hazard Control Supervisor

The Contractor shall be represented on site by a supervisor, trained using the model Contractor accreditation plan as indicated in the Federal statutes for all portions of the herein listed work.

1.3.8 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic

Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

- a. Local exhaust equipment G
- b. Vacuums G
- c. Respirators G
- d. Pressure differential automatic recording instrument G
- e. Amended water G
- f. Glovebags G
- g. Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site G
- h. Encapsulants G

1.4.2 SD-08, Statements

- a. Asbestos hazard abatement plan G
- b. Testing laboratory G
- c. Private qualified person documentation G
- d. Landfill approval G
- e. Employee training G
- f. Medical certification requirements G
- g. Waste shipment records and if applicable exemption report G
- h. Respiratory Protection Program G
- i. Hazardous waste manifest G

1.4.2.1 Asbestos Hazard Abatement Plan

Submit a detailed plan of the safety precautions such as lockout, tagout, tryout, fall protection, and confined space entry procedures and equipment and work procedures to be used in the removal and demolition of materials containing asbestos. The plan, not to be combined with other hazard abatement plans, shall be prepared, signed, and sealed by the PQP. Provide a Table of Contents for each abatement submittal, which shall follow the sequence of requirements in the contract. Such plan shall include but not be limited to the precise personal protective equipment to be used including, but not limited to, respiratory protection, type of whole-body protection and if reusable coveralls are to be employed decontamination methods (operations and quality control plan), the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed

description of the method to be employed in order to control environmental pollution. The plan shall also include (both fire and medical emergency) response plans. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work. The Contractor, Asbestos Hazard Control Supervisor, and PQP shall meet with the Contracting Officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to starting work.

1.4.2.2 Testing Laboratory

Submit the name, address, and telephone number of each testing laboratory selected for the sampling, analysis, and reporting of airborne concentrations of asbestos fibers along with evidence that each laboratory selected holds the appropriate State license and/or permits and certification that each laboratory is American Industrial Hygiene Association (AIHA) accredited and that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry (AAR) and successful participation of the laboratory in the Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials or transmission electron microscopy is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis.

1.4.2.3 Private Qualified Person Documentation

Submit the name, address, and telephone number of the Private Qualified Person (PQP) selected to prepare the Asbestos Hazard Abatement Plan, direct monitoring and training, and documented evidence that the PQP has successfully completed training in and is accredited and where required is certified as, a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer as described by 40 CFR 763 and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The PQP shall be appropriately licensed in the State of West Virginia.

1.4.2.4 Landfill Approval

Submit written evidence that the landfill for disposal is approved for asbestos disposal by the USEPA and State regulatory agency(s). Submit to the Contracting Officer, waste shipment records, prepared in accordance with Federal regulations, signed and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill, within 3 days after delivery. In those States that require a hazardous waste manifest the Contractor shall submit, within 3 days, signed copies of such to the Contracting Officer.

1.4.2.5 Employee Training

Submit certificates, prior to the start of work but after the main abatement submittal, signed by each employee indicating that the employee has received training in the proper handling of materials and wastes that contain asbestos in accordance with 40 CFR 763; understands the health implications and risks involved, including the illnesses possible from

exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis. Certificates shall be organized by individual worker, not grouped by type of certification. Post appropriate evidence of compliance with the training requirements of 40 CFR 763.

1.4.2.6 Medical Certification

Provide a written certification for each worker and supervisor, signed by a licensed physician indicating that the worker and supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1926.103 as prescribed by law. Submit certificates prior to the start of work but after the main abatement submittal.

1.4.2.7 Respiratory Protection Program

Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

1.4.3 SD-12, Field Test Reports

- a. Air sampling results G
- b. Pressure differential recordings for local exhaust systemG
- c. Asbestos disposal quantity report G
- d. Encapsulation test patches G
- e. Clearance sampling G

1.4.3.1 Air Sampling Results

Complete fiber counting and provide results to the PQP for review within 16 hours of the "time off" of the sample pump. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees where required by law within 3 working days, signed by the testing laboratory employee performing air sampling, the employee that analyzed the sample, and the PQP. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance shall levels exceed 0.1 fibers per cubic centimeter.

1.4.3.2 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external to the enclosure and operate it continuously, 24 hours a day, until the temporary enclosure of the asbestos control area is removed. Submit pressure differential recordings for each work day to the PQP for review and to the Contracting Officer within 24 hours from the end of each work day.

1.4.4 SD-13, Certificates

- a. Vacuums G
- b. Water filtration equipment G
- c. Ventilation systems G
- d. Other equipment used to contain airborne asbestos fibers G
- e. Chemical encapsulants sealers G

Show compliance with ANSI Z9.2 by providing manufacturers' certifications.

1.4.5 SD-18, Records

- a. Notifications G
- b. Rental equipment G
- c. Respirator program records G
- d. Permits G
- e. Protective clothing decontamination quality control recordsG
- f. Protective clothing decontamination facility notificationG

1.4.5.1 Notifications

Notify the Contracting Officer and other appropriate Government agencies in writing 10 working days prior to the start of asbestos work as indicated in applicable laws, ordinances, criteria, rules, and regulations.

1.4.5.2 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

1.4.5.3 Respirator Program Records

Submit records of the respirator program as required by ANSI Z88.2, 29 CFR 1926.103, and 29 CFR 1926.1101.

1.4.5.4 Protective Clothing Decontamination Quality Control Records

Provide all records that document quality control for the decontamination of reusable outer protective clothing.

1.4.5.5 Protective Clothing Decontamination Facility Notification

Submit written evidence that persons who decontaminate, store, or transport asbestos contaminated clothing used in the performance of this contract were duly notified in accordance with 29 CFR 1926.1101.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or

hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements.

2.1.1 Removal Encapsulants

<u>Requirement</u>	<u>Test Standard</u>
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96

2.1.2 Bridging Encapsulant

<u>Requirement</u>	<u>Test Standard</u>
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance - Minimum 43 in/lb	ASTM D 2794 Gardner Impact Test
Flexibility - no rupture or cracking	ASTM D 522 Mandrel Bend Test

2.1.3 Penetrating Encapsulant

<u>Requirement</u>	<u>Test Standard</u>
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96
Cohesion/Adhesion Test - 50 pounds of force/foot	ASTM E 736
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance - Minimum 43 in/lb	ASTM D 2794 Gardner Impact Test

<u>Requirement</u>	<u>Test Standard</u>
Flexibility - no rupture or cracking	ASTM D 522 Mandrel Bend Test
2.1.4 Lock-down Encapsulant	
<u>Requirement</u>	<u>Test Standard</u>
Flame Spread: 25, Smoke Emission - 50	ASTM E 84
Life Expectancy: 20 years	ASTM C 732 Accelerated Aging Test
Permeability: Minimum 0.4 perms	ASTM E 96
Fire Resistance: Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength: ASTM E 736 100 pounds of force/foot (Tests compatibility with cementitious and fibrous fireproofing)	

PART 3 EXECUTION

3.1 EQUIPMENT

At all times, provide the Contracting Officer or the Contracting Officer's Representative, with at least two complete sets of personal protective equipment as required for entry to and inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment used to contain airborne asbestos fibers.

3.1.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

3.1.1.1 Respirators for Handling Asbestos

Provide personnel engaged in pre-cleaning, cleanup, handling, removal and demolition of asbestos materials with respiratory protection as indicated in 29 CFR 1926.1101 and 29 CFR 1926.103.

3.1.2 Exterior Whole Body Protection

3.1.2.1 Outer Protective Clothing

Provide personnel exposed to asbestos with disposable "non-breathable," or reusable "non-breathable" whole body outer protective clothing, head

coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape. Reusable whole body outer protective clothing shall be either disposed of as asbestos contaminated waste upon exiting from the asbestos regulated work area or be properly decontaminated.

3.1.2.2 Work Clothing

Provide cloth work clothes for wear under the outer protective clothing and foot coverings and either dispose of or properly decontaminate them as recommended by the PQP after each use.

3.1.2.3 Personal Decontamination Unit

Provide a temporary, negative pressure unit with a separate decontamination locker room and clean locker room with a shower that complies with 29 CFR 1926.51(f)(4)(ii) through (V) in between for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. HEPA vacuum and remove asbestos contaminated reusable protective clothing while still wearing respirators at the boundary of the asbestos work area, seal in two impermeable bags, label outer bag as asbestos contaminated waste, and transport for decontamination. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing into street clothes. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste or properly decontaminate as specified in the Contractor's Asbestos Hazard Abatement Plan. Decontamination units shall be physically attached to the asbestos control area. Build both a personnel decontamination unit and an equipment decontamination unit onto and integral with each asbestos control area.

3.1.2.4 Decontamination of Reusable Outer Protective Clothing

When reusable outer protective clothing is used, transport the double bagged clothing to a previously notified commercial/industrial decontamination facility for decontamination. Perform non-destructive testing to determine the effectiveness of asbestos decontamination. If representative sampling is used, ensure the statistical validity of the sampling results. If representative sampling is used, reject any entire batch in which any of the pieces exceed 40 fibers per square millimeter. Inspect reusable protective clothing prior to use to ensure that it will provide adequate protection and is not or is not about to become ripped, torn, deteriorated, or damaged, and that it is not visibly contaminated. Notify, in writing, all personnel involved in the decontamination of reusable outer protective clothing as indicated in 29 CFR 1926.1101.

3.1.2.5 Eye Protection

Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

3.1.3 Warning Signs and Labels

Provide warning signs printed in English at all approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.1.3.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.200, and 29 CFR 1926.1101 minimum 20 by 14 inches displaying the following legend in the lower panel:

<u>Legend</u>	<u>Notation</u>
Danger	1-inch Sans Serif Gothic or Block
Asbestos	1-inch Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	1/4-inch Sans Serif Gothic or Block
Authorized Personnel Only	1/4-inch Gothic
Respirators and Protective Clothing are Required in this Area	1/4-inch Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

3.1.3.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

BREATHING ASBESTOS DUST MAY

CAUSE SERIOUS BODILY HARM

3.1.4 Tools

Vacuums shall be leak proof to the filter and equipped with HEPA filters. Filters on vacuums shall conform to ANSI Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

3.1.5 Rental Equipment

If rental equipment is to be used, furnish written notification to the rental agency concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

3.1.6 Glovebags

Submit written manufacturers proof that glovebags will not break down under expected temperatures and conditions.

3.2 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, and as specified herein. Use wet removal procedures. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, tobacco, or applying cosmetics shall not be permitted in the asbestos work or control areas. Personnel of other trades not engaged in the removal and demolition of asbestos containing material shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection and training provisions of this specification are complied with by the trade personnel. If an asbestos fiber release or spill occurs outside of the asbestos control area, stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

3.2.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent work. Where such work is damaged or contaminated as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained from the PQP work may proceed at the discretion of the Contracting Officer.

3.2.2 Asbestos Control Area Requirements

3.2.2.1 Glovebag

The construction of a negative pressure enclosure is infeasible for the removal of transite pipe located in the vicinity of Building 344 and the new treatment building. Use alternate techniques as indicated in 29 CFR 1926.1101. Establish designated limits for the asbestos regulated area with the use of rope or other continuous barriers, and maintain all other requirements for asbestos control areas. The PQP shall conduct personal

samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work) throughout the duration of the project. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers at any time exceeds background or 0.01 fibers per cubic centimeter whichever is greater, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those obtained by the Contractor, the Government will determine which results predominate. If adjacent areas are contaminated as determined by the Contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.

3.2.3 Removal Procedures

Wet asbestos material with a fine spray of amended water during removal, cutting, or other handling so as to reduce the emission of airborne fibers.

Remove material and immediately place in 6-mil plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water or wetting agent in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 6-mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation, wrap the pipes and insulation in plastic and remove the pipe by sections. Asbestos containing material shall be containerized while wet. At no time shall asbestos material be allowed to accumulate or become dry. Lower and otherwise handle asbestos containing material as indicated in 40 CFR 61-SUBPART M.

3.2.3.1 Sealing Contaminated Items Designated for Disposal

Remove contaminated pipes and fittings, conduit, and other contaminated items designated for removal by completely coating the items with an asbestos lock-down encapsulant at the demolition site before removing the items from the asbestos control area. These items need not be vacuumed. The asbestos lock-down encapsulant shall be tinted a contrasting color. It shall be spray-applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces. Lock-down encapsulants shall comply with the performance requirements specified herein.

3.2.3.2 Exposed Pipe Insulation Edges

Contain edges of asbestos insulation to remain that are exposed by a removal operation. Wet and cut the rough ends true and square with sharp tools and then encapsulate the edges with a 1/4-inch thick layer of non-asbestos containing insulating cement troweled to a smooth hard finish.

When cement is dry, lag the end with a layer of non-asbestos lagging cloth, overlapping the existing ends by at least 4 inches. When insulating cement and cloth is an impractical method of sealing a raw edge of asbestos, take appropriate steps to seal the raw edges as approved by the Contracting Officer.

3.2.4 Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed

in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the PQP. Sampling performed for environmental and quality control reasons shall be performed by the PQP. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate.

3.2.4.1 Sampling Prior to Asbestos Work

Provide area air sampling and establish the baseline one day prior to the masking and sealing operations for each demolition removal site. Establish the background by performing area sampling in similar but uncontaminated sites in the building.

3.2.4.2 Sampling During Asbestos Work

The PQP shall provide personal and area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. In addition, provided the same type of work is being performed, provide area sampling at least once every work shift close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. Where alternate methods are used, perform personal and area air sampling at locations and frequencies that will accurately characterize the evolving airborne asbestos levels.

The PQP shall provide personal sampling as indicated in 29 CFR 1926.1101. At the same time the NC will provide area sampling close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. In addition, provided the same type of work is being performed, the NC will provide area sampling once every work shift close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. Where alternate methods are used, perform personal and area air sampling at locations and frequencies that will accurately characterize the evolving airborne asbestos levels.

3.2.4.3 Sampling After Final Clean-Up (Clearance Sampling)

Provide area sampling of asbestos fibers and establish an airborne asbestos concentration of less than 0.01 fibers per cubic centimeter after final clean-up but before removal of the enclosure or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the PQP shall perform a visual inspection in accordance with ASTM E 1368 to ensure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Prepare a written report signed and dated by the PQP documenting that the asbestos control area is free of dust, dirt, and debris and all waste has been removed. Use transmission electron microscopy (TEM) to analyze clearance

samples and report the results in accordance with current NIOSH criteria. The asbestos fiber counts from these samples shall be less than 0.01 fibers per cubic centimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and TEM analysis at the Contractor's expense.

3.2.5 Lock-Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, the PQP shall conduct a visual inspection of all areas affected by the removal in accordance with ASTM E 1368. Inspect for any visible fibers.

3.2.6 Site Inspection

While performing asbestos engineering control work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the violation shall be at the Contractor's expense.

3.3 CLEAN-UP AND DISPOSAL

3.3.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the Contracting Officer will attest that the area is safe before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the enclosure removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect all surfaces within the enclosure for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The Contracting Officer must agree that the area is safe in writing before unrestricted entry will be permitted. The Government shall have the option to perform monitoring to determine if the areas are safe before entry is permitted.

3.3.2 Title to Materials

All waste materials, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, State, and Federal regulations and herein.

3.3.3 Disposal of Asbestos

3.3.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 6-mils thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 6-mils thick bags with the approved warnings and DOT labeling preprinted on the bag. The name of the waste generator and the location at which the waste was generated shall be clearly indicated on the outside of each container. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off Government property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Procedure for hauling and disposal shall comply with 40 CFR 61-SUBPART M, State, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

3.3.3.2 Asbestos Disposal Quantity Report

Direct the PQP to record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feet for the amount of asbestos containing material released for disposal.

Allow the Contracting Officer's Representative to inspect, record and report the amount of asbestos containing material removed and released for disposal on a daily basis.

-- End of Section --

SECTION 13390

PACKAGE CONTROL SYSTEMS

03/97

PART 1 GENERAL

1.1 REFERENCES

The following is a list of standards which may be referenced in this section:

1.2 SYSTEM DESCRIPTION

- a. Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.
- b. Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.3 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-01, Data

- a. Programmable Controller

1.3.1.1 Programmable Controller

- a. Complete set of user manuals.
- b. Fully documented ladder logic listings.
- c. Function listing for function blocks not fully documented by ladder logic listings.
- d. Cross-reference listing.
- e. Manufacturer's list of proposed spares, expandables, and test equipment.

1.3.2 SD-04, Drawings

1.3.2.1 Drawings

- a. Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
- b. Catalog information on electrical devices furnished with system.
- c. Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.
- d. Panel elementary diagrams of prewired panels. Include in diagrams

control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.

- e. Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
- f. Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.

1.3.3 SD-13, Certificates

- a. Manufacturer's Certificate of Proper Installation

1.3.3.1 Quality Control Submittals

Submit manufacturer's certificate of proper installation of package control systems.

1.4 DELIVERY, STORAGE, AND HANDLING

Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

1.5 SPARES, EXPENDABLES, AND TEST EQUIPMENT

1.5.1 Selector Switch, Pushbutton, and Indicating Light

20 percent, one minimum, of each type used.

1.5.2 Light Bulb

100 percent, two minimum, of each type used.

1.5.3 Fuse

100 percent, two minimum, of each type used.

1.5.4 Surge Suppressors

20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.1 GENERAL

Section 13402, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS):
Interface requirements to Package Control Systems.

2.2 SIGNAL CHARACTERISTICS

- a. Analog Signals:

- 1. 4 to 20 mA dc, in accordance with compatibility requirements of ISA S50.1.

- 2. Unless otherwise specified or shown, use Type 2, two-wire circuits.

- 3. Transmitters: Load resistance capability conforming to Class L.

4. Fully isolate input and output signals of transmitters and receivers.
- b. Pulse Frequency Signals: dc pulses whose repetition rate is linearly proportional to process variable over 10:1 range. Generate pulses by contact closures or solid state switches.
 1. Power source: Less than 30V dc.
- c. Discrete Signals:
 1. Two-state logic signals.
 2. Utilize 120V ac sources for control and alarm signals.
 3. Alarm signals shall be normally open, close to alarm isolated contacts rated for 5-ampere at 120V ac and 2-ampere at 30V dc.
- d. As defined in Section 13402, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS).

2.3 CORROSION PROTECTION

2.3.1 Corrosion-Inhibiting Vapor Capsule Manufacturers:

- a. Northern Instruments; Model Zerust VC.
- b. Hoffmann Engineering; Model A-HCI.
- c. Or equal..

2.4 CONTROL PANEL

- a. Conform to NEMA ratings as specified in individual equipment sections.
- b. Minimum Metal Thickness: 14 gauge.
- c. NEMA 250, Type 4X Panels: Type 316 stainless steel construction unless otherwise specified.
- d. Doors:
 1. Three-point latching mechanisms in accordance with NEMA 250, Type 1 and 12 panels with doors higher than 18 inches.
 2. For other doors, stainless steel quick release clamps.
- e. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.
- f. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.
- g. Temperature Control:
 1. Size panels to adequately dissipate heat generated by

equipment mounted on or in the panel.

2. Furnish cooling fans with air filters if required to dissipate heat.
3. For panels outdoors or in unheated areas, furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.
- h. Lighting: Minimum of one hand switch controlled internal 100-watt incandescent light for panels 12 cubic feet and larger.
- i. Minimum of one 120-volt duplex receptacle for panels 12 cubic feet and larger.
- j. Finish:
 1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer's standard gray unless otherwise specified.
 2. Internal Surfaces: White enamel.
- k. Panel Manufacturers:
 1. Hoffman.
 2. H.F. Cox.
 3. Or equal.
- l. Breather and Drains: Furnish with NEMA 250, Type X panels.
 1. Manufacturer and Product: Crouse-Hinds; Model ECD18, or equal.

2.5 CONTROL PANEL ELECTRICAL

2.5.1 Control Panels Without Motor Starters

- a. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
- b. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
- c. Circuit Breakers:
 1. Coordinate for fault in branch circuit trips, branch breaker, and not main breaker.
 2. Branch Circuit Breakers: 15 amps at 250V ac.
 3. Breaker Manufacturers and Products:
 - a) Heineman Electric Co.; Series AM.
 - b) Airpax/North American Philips Controls Corp.; Series 205.
 - c) Or equal.

2.5.2 Control Panels with Three-Phase Power Supplies and Motor Starters

- a. Interlock main circuit breaker with panel door.
 - 1. Mount logic controls, branch circuit breakers, overload reset switches, and other control circuit devices.
 - 2. Mount operator controls and indications on front access door.
- b. Circuit Breakers:
 - 1. In accordance with NEMA AB 1.
 - 2. 18,000-ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified.
 - 3. Breakers Except Motor Branch Breakers: Molded case thermal magnetic.
 - 4. Motor Branch Circuit Breakers:
 - a) 50 hp and Less: Magnetic.
 - b) Larger than 50 hp: Thermal magnetic with adjustable magnetic trip units.
 - c) Ratings: Recommended by manufacturer for maximum motor protection.
 - d) Padlock Provisions: OFF position.
 - 5. Tripping: Indicate with operator handle position.
- c. Magnetic Motor Starters:
 - 1. Full voltage, NEMA ICS 2, Class A, Size 0 minimum.
 - 2. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
 - 3. Manual reset type with reset button mounted on panel door.
- d. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
 - 1. Power Control Transformer:
 - a) Sufficient capacity to serve connected load, including 200VA for duplex outlet plus 100VA (minimum) and any instrumentation provided with packages.
 - b) Limit voltage variation to 15 percent during contact pickup.
 - c) Fuse one side of secondary winding and ground the other.
 - d) Furnish primary winding fuses in underground conductors.
- e. Power Monitoring Relay:

1. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
2. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
3. Transient Voltage Protection: 10,000 volts.
4. Manufacturer and Product: Furnace; Class 47.
- f. Power Distribution Blocks: Furnish to parallel feed top on branch circuit protective devices. Do not "leap frog" power conductors.
- g. Terminations for Power Conductors: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

2.5.3 Wiring

- a. ac Circuits:
 1. Type: 600-volt, Type MTW stranded copper.
 2. Size: For current to be carried, but not less than No. 14 AWG.
- b. Analog Signal Circuits:
 1. Type: 300-volt, Type 2 stranded copper, twisted shielded pairs.
 2. Size: No. 18 AWG, minimum.
- c. Other dc Circuits:
 1. Type: 600-volt, Type MTW stranded copper.
 2. Size: No. 18 AWG, minimum.
- d. Separate analog and other dc circuits at least 6 inches from any ac power and control wiring.
- e. Enclose wiring in sheet metal raceways or plastic wiring ducts.
- f. Wire Identification:
 1. Numbered and tagged at each termination.
 2. Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Do not use adhesive or taped-on tags.

2.5.4 Wiring Interface

- a. For analog and discrete signal, terminate at numbered terminal blocks.
- b. For special signals, terminate power (240 volts or greater) at manufacturer's standard connectors.
- c. For panel, terminate at equipment on/with which it is mounted.

2.5.5 Terminal Blocks

a. Quantity:

1. For external connections.
2. Wire spare or unused panel mounted elements to their panels' terminal blocks.
3. Spare Terminals: 20 percent of connected terminals, but not less than 10.

b. General: Group to keep 120V ac circuits separate from 24V dc circuits.

1. Connection Type: Screw connection clamp.

2. Compression Clamp:

a) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.

b) Guides strands of wire into terminal.

3. Screws: Hardened steel, captive and self-locking.

4. Current Bar: Copper or treated brass.

5. Insulation:

a) Thermoplastic rated for minus 55 to plus 110 degrees C.

b) Two funnel shaped inputs to facilitate wire entry.

6. Mounting:

a) Rail.

b) Terminal block can be extracted from an assembly without displacing adjacent blocks.

c) End Stops: One at each end of rail, minimum.

7. Wire Preparation: Stripping only.

8. Jumpers: Allow jumper installation without loss of space on terminal or rail.

9. Marking System:

a) Terminal number shown on both sides of terminal block

b) Allow use of preprinted and field marked tags.

c) Terminal strip numbers shown on end stops.

d) Mark terminal block and terminal strip numbers as shown.

c. Terminal Block, 120-Volt Power:

1. Rated Voltage: 600V ac.
 2. Rated Current: 30 amp.
 3. Wire Size: P22-10 AWG.
 4. Rated Wire Size: 10 AWG.
 5. Color: Grey body.
 6. Spacing: 0.25 inch, maximum.
- d. Terminal Block, Ground:
1. Wire Size: 22-12 AWG.
 2. Rated Wire Size: 12 AWG.
 3. Color: Green and yellow body.
 4. Spacing: 0.25 inch, maximum.
 5. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
- e. Terminal Block, Blade Disconnect Switch:
1. Use: Provide one for each discrete input and output field interface wire.
 2. Rated Voltage: 600V ac.
 3. Rated Current: 10 amp.
 4. Wire Size: 22-12 AWG.
 5. Rated Wire Size: 12 AWG.
 6. Color: Grey body, orange switch.
 7. Spacing: 0.25 inch, maximum
- f. Terminal Block, Fused, 24V dc:
1. Rated Voltage: 600V dc.
 2. Rated Current: 6.3 amp.
 3. Wire Size: 22-12 AWG.
 4. Rated Wire Size: 12 AWG.
 5. Color: Grey body.
 6. Fuse: 5 by 20 GMA fuses.
 7. Fuse Marking: Fuse amperage rating shown on top of terminal block.

8. Indication: LED diode 24V dc.
 9. Leakage Current: 5.2 mA, maximum.
 10. Spacing: 0.32 inch, maximum
- g. Terminal Block, Fused, 120V ac:
1. Rated Voltage: 600 V ac.
 2. Rated Current: 6.3 amp.
 3. Wire Size: 22-12 AWG
 4. Rated Wire Size: 12 AWG.
 5. Color: Grey body.
 6. Fuse: 5 by 20 GMA fuses.
 7. Fuse Marking: Fuse amperage rating shown on top of terminal block.
 8. Indication: Neon lamp 110V ac.
 9. Leakage Current: 1.8 mA, maximum.
 10. Spacing: 0.32 inch, maximum

2.5.6 Grounding

Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

2.5.7 Relays

a. General:

1. Relay Mounting: Plug-in type socket.
2. Relay Enclosure: Provide dust cover.
3. Socket Type: Screw terminal interface with wiring.
4. Socket Mounting: Rail.
5. Furnish holddown clips.

b. Control Circuit Switching Relay, Nonlatching:

1. Type: Compact general purpose plug-in.
2. Contact Arrangement: 3 Form C contacts.
3. Contact Rating: 10A at 28V dc or 240V ac.
4. Contact Material: Silver cadmium oxide alloy.

5. Coil Voltage: As noted or shown.
 6. Coil Power: 1.8 watts (dc), 2.7VA (ac).
 7. Expected Mechanical Life: 10,000,000 operations.
 8. Expected Electrical Life at Rated Load: 100,000 operations.
 9. Indication Type: Neon or LED indicator lamp.
 10. Push-to-test button.
- c. Control Circuit Switching Relay, Latching:
1. Type: Dual coil mechanical latching relay.
 2. Contact Arrangement: 2 Form C contacts.
 3. Contact Rating: 10A at 28V dc or 120V ac.
 4. Contact Material: Silver cadmium oxide alloy.
 5. Coil Voltage: As noted or shown.
 6. Coil Power: 2.7 watts (dc), 5.3VA (ac).
 7. Expected Mechanical Life: 500,000 operations.
 8. Expected Electrical Life at Rated Load: 50,000 operations.
- d. Control Circuit Switching Relay, Time Delay:
1. Type: Adjustable time delay relay.
 2. Contact Arrangement: 2 Form C contacts.
 3. Contact Rating: 10A at 240V ac.
 4. Contact Material: Silver cadmium oxide alloy.
 5. Coil Voltage: As specified or shown.
 6. Operating Temperature: Minus 10 to 55 degrees C.
 7. Repeatability: Plus or minus 2 percent.
 8. Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent or range.
 9. Time Delay Set Point: As specified or shown.
 10. Mode of Operation: As specified or shown.
 11. Adjustment Type: Integral potentiometer with knob external to dust cover.

2.5.8 Intrinsic Safety Barriers

a. Intrinsically Safe Relays

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

1. Monitor discrete signals that originate in hazardous area and are used in a safe area.

2. Manufacturer and Product: MTL, Inc.; Series MTL 2000.

b. Intrinsically Safe Barriers

1. Interface analog signals as they pass from hazardous area to safe area.

2.5.9 Front-of-Panel Devices in Conjunction with NEMA 250, Type 1 and 12 Panels

a. Potentiometer Units:

1. Three-terminal, oiltight construction, resolution of 1 percent and linearity of plus or minus 5 percent.

2. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.

3. Include legend plates with service markings.

b. Indicating Lights:

1. Heavy-duty, push-to-test type, oiltight, industrial type with integral transformer for 120V ac applications.

2. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.

c. Pushbutton, Momentary:

1. Heavy-duty, oiltight, industrial type with full guard and momentary contacts rated for 10 amperes continuous at 120V ac.

2. Standard size legend plates with black field and white markings for service legend.

d. Selector Switch:

1. Heavy-duty, oiltight, industrial type with contacts rated for 120V ac service at 10 amperes continuous.

2. Standard size, black field, legend plates with white markings, for service legend.

3. Operators: Black knob type.

4. Single-hole mounting, accommodating panel thicknesses from 1/16 to 1/4 inch.

2.5.10 Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels

a. Potentiometer, Watertight:

1. Three-terminal, heavy-duty NEMA 250, Type 4X watertight

construction, resolution of 1 percent and linearity of plus or minus 5 percent.

2. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.

3. Include engraved legend plates with service markings.

b. Indicating Lights, Watertight:

1. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.

2. Screwed on prismatic lenses and factory engraved legend plates for service legend.

c. Pushbutton, Momentary, Watertight:

1. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.

2. Standard size, black field, legend plates with white markings for service legend.

d. Selector Switch, Watertight:

1. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.

2. Standard size, black field, legend plates with white markings, for service legend.

3. Operators: Black knob type.

4. Single-hole mounting, accommodating panel thicknesses from 1/16 to 1/4 inch.

2.6 INSTRUMENT TAG NUMBERS

a. A shorthand tag number notation is used. For example:

AI-1-12(2)(3)

<u>Notation</u>	<u>Explanation</u>
AI	ISA designator for Analysis Indicator
1	Unit process number
12	Loop number
(2)	First unit number; number of same component types in a given loop; -1 and 1-2 in this example
(3)	Second unit number; number of same component types with same first unit number in a given

loop; -1, -2, and -3 in this example

- b. In this example, AI-1-12(2)(3) is shorthand for:

AI-1-12-1-1, AI-1-12-1-2, AI-1-12-1-3

AI-1-12-2-1, AI-1-12-2-2, AI-1-12-2-3

2.7 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

2.7.1 Nametags

Permanently mounted bearing entire ISA tag number.

- Panel Mounted: Plastic, mounted to instrument behind panel face.
- Field Mounted: Engraved Type 316 stainless steel, 22-gauge minimum thickness, attach with stainless steel.

2.7.2 Service Legends (Integrally Mounted with Instrument) and Nameplates

- Engraved, rigid, laminated plastic type with adhesive back. Furnish service legends and nameplates to adequately describe functions of panel face mounted instruments.
- Color: White with black letters. Letter height 3/16 inch.
- For each panel, face mounted laminated nameplate inscribed with the panel name and tag number. Color shall be white with black letters 1/2-inch high.

2.7.3 Standard Light Colors and Inscriptions

Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow
FORWARD	FORWARD	Red
REVERSE	REVERSE	Blue

- Lettering: Black on white and amber lenses; white on red and green lenses.
- Standard Pushbutton Colors and Inscriptions:

1. Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
OO	ON OFF	Red Green
OC	OPEN CLOSED	Red Green
SS	START STOP	Red Green
FR	FORWARD REVERSE	Red Blue
RESET	RESET	Black
OCA	OPEN CLOSE AUTO	Red Green White
OOA	ON OFF AUTO	Red Green White
MA	MANUAL AUTO	Yellow White
EMERGENCY STOP	EMERGENCY STOP	Red

2. Unused or noninscribed buttons shall be black. Lettering: Black on white and yellow buttons; white on black, red and green buttons.

2.8 ELECTRICAL SURGE AND TRANSIENT PROTECTION

2.8.1 General

Equip control panels with surge-arresting devices to protect equipment from damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

2.8.2 Suppressor Locations

- At point of connection between each equipment item, including ac powered transmitters and its power supply conductors (direct wired equipment).
- On analog pairs at each end when the pair travels outside of building.
- In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

2.8.3 Power Supply Suppressor Assemblies

- a. Suitable for connection to 120-volt, single-phase power supplies EDCO "HSP SERIES."
- b. Suitable for connection to 480-volt, three-phase power supplies; Square D J9200-9A.

2.8.4 Analog Signal Cable Suppressor Assemblies

- a. Epoxy encapsulated within a phenolic enclosure.
- b. Flame retardant.
- c. Four lead devices; include a threaded mounting/grounding stud.
- d. Manufacturers and Products
 - 1. EDCO; SRA-64 Series.
 - 2. Joslyn; Series 1800 and 1669.

2.8.5 Grounding

Coordinate surge suppressor grounding in field panels and field instrumentation as specified in Section 16402, "Interior Distribution System," and suppressor manufacturer's requirements. Furnish control panels with an integral copper grounding bus for connection of suppressors and other required instrumentation.

PART 3 EXECUTION

3.1 ELECTRICAL POWER AND SIGNAL WIRING

- a. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting will occur around the longitudinal axis of wire. Protect bend area with a sleeve.
- b. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.
- c. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.
- d. Do not splice or tap wiring except at device terminals or terminal blocks.

3.2 PROTECTION

- a. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.
- b. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

-- End of Section --

SECTION 13402

PROCESS INSTRUMENTATION AND CONTROL SYSTEMS (PICS)

03/97

PART 1 GENERAL

1.1 REFERENCES

American Society for Testing and Materials (ASTM)

- | | |
|-----------|---|
| ASTM A182 | Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service. |
| ASTM A276 | Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes. |
| ASTM A312 | Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes. |
| ASTM B32 | Standard Specification for Solder Metal. |
| ASTM B88 | Standard Specification for Seamless Copper Water Tube. |

Instrument Society of America (ISA)

- | | |
|-----------|---|
| ISA S5.1 | Instrumentation Symbols and Identification (NRC ADOPTED). |
| ISA S5.4 | Standard Instrument Loop Diagrams. |
| ISA S20 | Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves. |
| ISA S50.1 | Compatibility of Analog Signals for Electronic Industrial Process Instruments. |

National Electrical Manufacturers Association (NEMA)

- | | |
|----------|--|
| NEMA 250 | Enclosures for Electrical Equipment (1,000 Volts Maximum). |
|----------|--|

1.2 SUMMARY

1.2.1 Work Includes

Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for a complete Process Instrumentation and Control System. Major parts are:

- a. Primary elements, transmitters, and control devices specified in Section 13000, "Instrumentation Components."

- b. One freestanding control panel ACP-1.
- c. One programmable logic controller and I/O hardware.
- d. Two process computers with system operating software and standard process monitoring/control software package.
- e. Data Highway.
- f. Two copies of programmable logic controller programming software.
- g. One copy of PC remote communications software and two modems.
- h. PC Programming software development.
- i. Seven non-freestanding vault control panels (one in each electrical vault: EV 1/2/3/4/34, EV 5/6/7/33, EV 8/9/10/32, EV 11/12/13/14/30/31, EV 15/16/17/18/29, EV 19/20/21/22/28, EV 23/24/25/26/27)

1.2.2 Detailed Design

PICS as shown and specified includes functional and performance requirements and component specifications. Complete detailed PICS design.

1.2.3 Applications Software

Provided by Engineer for PLCs and Computers. Contractor required support to include following activities:

- a. Early delivery of PLC and PLC programming equipment to Engineer's office.
- b. Demonstration testing of PLC and PLC programming equipment at Engineer's office.
- c. Assistance with onsite check out of applications software.
- d. As specified in Article SEQUENCE AND SCHEDULING.

1.3 DEFINITIONS

1.3.1 Abbreviations

- a. CADD: Computer Assisted Design and Drafting.
- b. MCC: Motor Control Center.
- c. ORT: Operational Readiness Test.
- d. PAT: Performance Acceptance Test.
- e. PLC: Programmable Logic Controller.
- f. PC: Personal Computer.
- g. CPU: Central Processing Unit.
- h. DCS: Distributed Control System.

- i. ACP-1: Area Control Panel Number 1.
- j. I/O: Input and/or output.
- k. UPS: Uninterrupted Power Source.

1.3.2 Rising/Falling

Terms used to define actions of discrete devices about their set points.

1.3.2.1 Rising

Contacts change state when an increasing process variable rises through set point.

1.3.2.2 Falling

Contacts change state when a decreasing process variable falls through set point.

1.3.3 Signal Types

a. Analog Signals, Current Type:

- 1. 4 to 20 mA dc signals conforming to ISA S50.1.
- 2. Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options:

- a) Transmitter Type: Number 2, two-wire.
- b) Transmitter Load Resistance Capacity: Class L.
- c) Fully isolated transmitters and receivers.

b. Analog Signals, Voltage Type: 1 to 5 volts dc within panels where a common high precision dropping resistor is used.

c. Discrete signals, two-state logic signals using 24V dc or 120V ac sources as indicated.

d. Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

1.3.4 Software

- a. Programming of digital devices using all types of programming languages.
- b. Configuring of digital devices using all types of configuring processes.
- c. Programs or configuration data stored in read only memory, programmable read only memory, read/write memory, disk, tape, or other storage device.

1.3.5 Types of Software

- a. Standard Software: Software packages that are independent of

project on which they are used. Standard software includes system software and process monitoring and control software.

1. System Software: Application independent software developed by digital equipment manufacturers and software companies. Includes, but is not limited to, operating systems; programming languages such as BASIC and C; assemblers; file management utilities; text editors; debugging aids; and diagnostics.
2. Process Monitoring and Control Software (PMCS): Software packages independent of specific process control projects on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, man-machine interface, data collection, data retrieval, trending, report generation, and diagnostics.

b. Applications Software:

1. Software to provide functions unique to this Project and that are not provided by standard software alone.
2. Configuring data bases, tables, displays, reports, parameter lists, ladder logic, and control strategies required to implement functions unique to this Project.

1.3.6 Instrument Tag Numbers

- a. A shorthand tag number notation. For example: AI-1-12(2)(3)

<u>Notation</u>	<u>Explanation</u>
AI	ISA designator for Analysis Indicator.
1	Unit process number.
12	Loop number.
(2)	First unit number; number of same component types in a given loop; -1 and -2 in this example.
(3)	Second unit number; number of same component types with same first unit number in a given loop; -1, -2, and -3 in this example.

- b. In this example, AI-1-12(2)(3) is shorthand for:

AI-1-12-1-1, AI-1-12-1-2, AI-1-12-1-3
AI-1-12-2-1, AI-1-12-2-2, AI-1-12-2-3

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract. Identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring and terminals).

- a. Submittals for Panel Control Diagrams, Panel Wiring Diagrams, Loop Diagrams, and Interconnecting Diagrams:

1. Shop Drawings: Submit required number of hard copies; i.e.,

paper copies.

2. Quality Control Submittals: As part of O&M Manuals:

a) Submit required number of hard copies; i.e., paper and reproducible copies.

b) Also submit one copy on floppy disc or tape drive in CADD format.

b. Legends and Abbreviation Lists: Complete definition of symbols and abbreviations used on this Project (e.g., engineering units, flow streams, instruments, structures, and other process items used in nameplates, legends, and data sheets).

c. Bill-of-Materials: List of required equipment.

1. Group equipment items as follows:

a) ACP-1 and associated components (PLC, I/O racks, etc.)

b) Other Equipment: By equipment type.

2. Data Included:

a) Equipment tag number.

b) Description.

c) Manufacturer, complete model number, and all options not defined by model number.

d) Quantity supplied.

e) Component identification code where applicable.

1.4.1 SD-02, Manufacturer's Catalog Data

a. ACP-1 (including PLC, I/O cards, and freestanding panel and panel accessories) G

b. Personal Computer G

c. Software G

d. UPS G

e. Printer G

1.4.1.1 Manufacturer's Catalog Data

Electrical Devices and Mechanical Devices:

a. Catalog information, mark to identify proposed items and options.

b. Descriptive literature.

c. External power and signal connections.

d. Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.

1.4.2 SD-04 Drawings

- a. Panel Construction Drawings: ACP-1 and seven nonfreestanding vault control panels G
- b. Panel Wiring Diagrams: ACP-1 and seven nonfreestanding vault control panels G
- c. Interconnecting Wiring Diagrams G
- d. Panel

1.4.2.1 Panel Construction Drawings

- a. Scale Drawings: Show dimensions and location of panel mounted devices, doors, louvers, and subpanels, internal and external.
- b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
- c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
- d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
- e. Construction Notes: Finishes, wire color schemes, wire ratings, wire and terminal block, numbering and labeling scheme.

1.4.2.2 Panel Wiring Diagrams

For discrete control and power circuits.

- a. Diagram Type: Ladder diagrams. Include devices, related to discrete functions, that are mounted in or on the panel and that require electrical connections. Show unique rung numbers on left side of each rung.
- b. Item Identification: Identify each item with attributes listed.
 - 1. Wires: Wire number. Cable number if part of multiconductor cable.
 - 2. Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - 3. Discrete Components:
 - a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), set point value and units, and process variable description (e.g., Sump Level High).
 - 4. Relay Coils:

- a) Tag number and its function.
 - b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
5. Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
- c. Show each circuit individually. No "typical" diagrams or "typical" wire lists will be permitted.
 - d. Ground wires, surge protectors, and connections.
 - e. Show point-to-point and terminal-to-terminal wiring within panel.

1.4.2.3 Interconnecting Wiring Diagrams

Provide a reproducible copy, plus CADD file on disk of the following:

- a. Provide interconnect diagrams for each analog PLC input, each analog PLC output, each discrete PLC input, and each discrete PLC output.
- b. Diagrams, device designations, and symbols in accordance with NEMA 250.
- c. Diagrams shall bear electrical Subcontractor's signature attesting diagrams have been coordinated with Division 16, ELECTRICAL.
- d. Show:
 - 1. Electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.
 - 2. Component and panel terminal board identification numbers, and external wire and cable numbers.
 - 3. Circuit names matching Circuit and Raceway Schedule.
 - 4. Intermediate terminations between field elements and panels for, e.g., to terminal junction boxes and pull boxes.
 - 5. Pull boxes.
- e. Spares: List of spares, expendables, test equipment and tools.
- f. Additional Equipment Recommended: List of, and descriptive literature for, additional spares, expendables, test equipment and tools recommended.
- g. PLC related submittals
 - 1. PLC I/O List
 - 2. PLC hardware and standard software (i.e., programming and documentation) user manuals.
 - 3. Submittal information on all PLC I/O modules, I/O bases, communication and network modules, memory, cables, etc.

4. Programming computer (including standard software and additional components (as specified)).
- h. Computer related submittals
 1. Bill-of-material for computer related components.
 2. Catalog cuts for all major computer related components.
 3. Power Connection/Interconnecting Wiring and Cabling Diagram.
 4. System Software: Complete reference information for system users.
 5. Standard Process Monitoring/Control Software: Detailed technical reference manuals and user level manuals.
 6. Disk and Memory Requirements: Table showing CPU and disk memory requirements for each software package.
- 1.4.3 SD-19, Operation and Maintenance Manuals
 - a. ACP-1 and accessories (PLC, I/O cards, etc.), data package 4. Also include equipment user's manuals. G
 - b. Personal computers and accessories (communication card, software, etc.), data package 4. Also include system software and hardware manuals. G
 - c. Uninterrupted Power Source (UPS) G
 - d. Printer
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Calibration Instruments

Each instrument used for calibrating PICS equipment shall bear the seal of a reputable laboratory certifying that instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
 - 1.5.2 Acceptable PICS Subcontractors

Owner acceptance of PICS Subcontractor does not exempt PICS Subcontractor or Contractor from meeting all Contract Document requirements nor does it give prior acceptance of subsystems, equipment, materials, or services.
- 1.6 SYSTEM PROGRAMMING
 - a. In order to complete the system application programming, the PICS Subcontractor shall deliver to the Engineer's Reston, Virginia office, all equipment necessary to program the PLC and the host computers. Equipment shall include one PLC, a programming microcomputer, programming software, two computers, all the network required for communications, the process monitoring and control software, and the vendor's operation and programming documentation. Equipment shall be delivered at least 6 months

prior to installation at the jobsite and after PICS Subcontractor assigned PLC I/O numbering has been submitted and approved.

- b. The PICS Subcontractor shall uncrate the equipment upon delivery and inspect it for shipping damage in the presence of the Engineer. The PICS Subcontractor shall install, connect all cables, and demonstrate to the Engineer that the programmable controller and computers are operational and ready for programming. The PICS Subcontractor shall provide the following additional hardware:

- 1. PLC data highway adapters, one I/O rack, one I/O rack power supply, one I/O base controller, and interconnecting cables.

- 2. One discrete input simulator consisting of 16 points minimum and one discrete output simulator consisting of 16 points minimum. One analog input simulator consisting of 4 points minimum and one analog output simulator consisting of 4 points minimum.

- 3. Necessary manuals to program PLC and computers.

- c. The PICS Subcontractor shall provide a complete listing of all hardware and software delivered to the Engineer's office. The listing shall include, as a minimum:

- 1. Component code as used in these specifications.

- 2. Description.

- 3. Quantity supplied.

- 4. Complete make, model and serial numbers.

- 5. Space for the Engineer and PICS Subcontractor to sign off upon delivery of item to the Engineer's office.

- d. The Engineer and PICS Subcontractor shall agree on the condition of the equipment before it is released to the Engineer's custody.

- e. While the equipment is at the Engineer's office, the Engineer shall be responsible for losses due to fire, theft, or physical abuse. However, the PICS Subcontractor shall be responsible to repair or replace any failures due to faulty components and to correct any system software failures.

1.7 DELIVERY, STORAGE, AND HANDLING

- a. Provide site and warehouse storage facilities for PICS equipment.

- b. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.

- c. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

- d. Cover panels and other elements that are exposed to dusty

construction environments.

1.8 SEQUENCING AND SCHEDULING

1.8.1 Activity Completion

The following is a list of key activities and their completion criteria:

1. Shop Drawings: Reviewed and approved.
2. Quality Control Submittals: Reviewed and accepted.
3. Hardware Delivery: Hardware delivered to site and inventoried by Owner.
4. PLC/Computer Delivery: Hardware and software delivered to Engineer's office and inventoried by Engineer.
5. PAT: Completed and required test documentation accepted.

1.8.2 PICS Substantial Completion

When Engineer issues Certificate of Substantial Completion.

1. Prerequisites:
 - a) All PICS Submittals have been completed.
 - b) PICS has successfully completed PAT.
 - c) Owner training plan is on schedule.
 - d) All spares, expendables, and test equipment have been delivered to Owner.

1.8.3 PICS Acceptance

When Engineer issues a written notice of Final Payment and Acceptance.

1. Prerequisites:
 - a) Certificate of Substantial Completion issued for PICS.
 - b) Punch-list items completed.
 - c) Final revisions to O&M manuals accepted.
 - d) Maintenance service agreements for PICS accepted by Owner.

1.8.4 Prerequisite Activities and Lead Times

Do not start the following key Project activities until the prerequisite activities and lead times listed below have been completed and satisfied:

<u>Activity</u>	<u>Prerequisites and Lead Times</u>
Submittal reviews by	Engineer acceptance of Submittal breakdown and schedule.
Hardware purchasing, fabrication, and assembly	Associated shop drawing Submittals completed.
Shipment	Completion of PICS Shop Drawing Submittals and preliminary O&M manuals.

<u>Activity</u>	<u>Prerequisites and Lead Times</u>
Owner Training	Owner training plan completed
PAT	Startup, Owner training, and PAT procedures completed; notice 4 weeks prior to start.

1.8.5 Partial Payment Limits

Following table gives partial payment limits for certain PICS work items.

<u>PICS Work Item</u>	<u>Limit As a Percent of Lump Sum Item Amount</u>
Administrative and Shop Drawing Submittals	15 percent, maximum
Performance Acceptance Test	10 percent, minimum
PICS O&M Manuals	5 percent, minimum

PART 2 PRODUCTS

2.1 GENERAL

- a. PICS functions as shown on Drawings and as required for each loop. Furnish equipment items as required. Furnish all materials, equipment, and software, necessary to effect required system and loop performance.
- b. First Named Manufacturer: PICS design is based on first named manufacturers of equipment and materials.
 1. If an item is proposed from other than first named manufacturer, obtain approval from Engineer for such changes in accordance with Article SUBMITTALS.
 2. If proposed item requires, i.e., different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories, furnish equipment and work.
- c. Like Equipment Items:
 1. Use products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.
 2. Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

2.2 I&C COMPONENTS

- a. See Section 13000, "Instrumentation Components."
- b. Personal Computer, Desktop:
 1. General:

- a) Function: Provide man-machine interface to process.
- b) Type: 100 percent IBM compatible.
- 2. Micro-Computer:
 - a) Microprocessor: Intel Pentium operating at 60-MHz, minimum.
 - b) Random Access Memory: 32 Mbytes, minimum.
 - c) Hard Disk:
 - 1) Type: IDE (PCI).
 - 2) Access Speed: 15 ms, maximum.
 - 3) Capacity: 2GB minimum.
 - d) Floppy Drive:
 - 1) CD-ROM drive, minimum 6x speed.
 - 2) 1.44 Mbyte, 3.5-inch high density floppy diskette drive.
 - e) Expansion Slots:
 - 1) PCI 64-bit slots, two minimum.
 - 2) ISA 16-bit slots, four minimum.
 - 3) Combination PCI/ISA slots, one minimum.
 - f) Communication Ports:
 - 1) RS-232 serial ports, two minimum.
 - 2) Parallel Ports:
 - a. Printer port, one minimum.
 - b. Bi-directional software key port, one minimum.
 - g) Keyboard: 101-key, enhanced.
 - h) Power: 90 to 120V ac, 50/60-Hz, unless otherwise noted.
- 3. Video Output:
 - a) Video Card:
 - 1) Type: PCI local bus SVGA color graphics.
 - 2) Memory: 1 Mbyte VRAM, minimum.
 - b) Monitor:
 - 1) Type: Noninterlace SVGA color 1024 x 768, minimum.
 - 2) Pixels: 0.28 mm dp, minimum.
 - 3) Size: 21-inch diagonal, unless otherwise noted.
 - 4) Power: 90 to 120V ac, 50/60-Hz, unless otherwise noted.
- 4. Pointing Device:
 - a) Mouse: Two-button, serial type with 6-foot cable.
 - b) Software: Device driver to interface with system software.
 - c) Accessories: Desypad.
- 5. System Software:
 - a) Microsoft DOS, Version 6.0 or later.
 - b) Microsoft Windows, NT.
- 6. Utility Software:
 - a) WordPerfect for Windows, Version 6.0A or later.
 - b) Excel for Windows, Version 4.01 or later.
- 7. PLC adapter SA85 and driver software, installed before shipping.
- 8. Modem: 28.8 speed.
- c. Process Control Software, Personal Computer:
 - 1. General:
 - a) Function: Provide man-machine interface to process.
 - b) Type: 100 percent Microsoft Windows NT compatible.
 - c) Minimum Point Count: 600.
 - 2. Features:
 - a) Operation:
 - 1) The system must be capable of operating as a distributed Client/Server architecture with local area network support for Ethernet and Token Ring network adaptors and the use of NetBIOS or TCP/IP network protocols. Network error detection,

recovery and diagnostics must be standard and require no programming for implementation.

2) The system must be capable of operating as a stand-alone system providing all the following system features. Reconfiguration or duplication of tag names shall not be required if a stand-alone system is modified to a networked system.

b) Data Acquisition and Control:

1) Memory resident real-time database that is continually updated with the most recent data from field devices via communication device drivers and operator interaction via the graphical user interface.

2) Real-time database data types available include floating point, integer, timers, counters and strings.

3) Configuration Capability: No programming, compiling or linking shall be required to configure the system. The system must be configurable on-line without compromising the data acquisition, process control, and data archiving functions.

4) Calculation Capability:

a. Arithmetic Operators: Equal, Add, Subtract, Multiply, Divide, Square Root, Natural and Common Logarithms, Absolute Value, and Exponentiation.

b. Relational Operators: Equal, Not Equal, Greater Than, Greater Than or Equal, Less Than, and Less Than or Equal.

c. Boolean Operators: Equal, And, Or, Not, Xor, Not Equal, Nand, and Parentheses.

d. Combined Operations: Boolean Conditioned Level and Edge Triggered Arithmetic, and Boolean Calculations.

e. Special Operations: Convert Floating Point to Integer.

c) Graphical User Interface:

1) Fully integrated MS Windows functionality.

2) 256-color palette for graphics build.

3) Point-and-Click graphics build with Rectangle/Square, Circle/Oval, Line, Polyline, Polygon, and Text drawing tools.

4) Point-and-Click operator interaction.

5) Manual data entry fields.

6) Prebuilt linked objects library.

7) Prebuilt Symbol Library:

a. ISA symbols

b. Common vessels and equipment.

c. PID faceplates.

8) User-built symbol library.

9) Selectable graphic font and size.

10) Graphic animation must be provided for foreground, edge and background color changes, horizontal and vertical object fill percentage, horizontal, vertical, rotational, and scalable position, command and visibility.

d) Alarming and Alarm Management:

1) Analog inputs must support High High, High, Low, Low Low, Time rate-of-change, Bad data input, Alarm disable, Off scan, Deadband, and Deviation alarm types.

2) Discrete inputs must support Change from normal (NO or NC), Return to normal, Change of state, Bad input, Alarm disable, and Off scan alarm types.

3) PID control block must support all analog inputs alarm types and Deviation from set point alarm type.

4) Must support a minimum of three alarm levels of priority and a maximum of 16 alarm areas with the ability to assign any alarm point to any priority level and either zero, 1 to 9, or all 16 alarm areas.

5) Counting of acknowledged and unacknowledged alarms by priority and alarm area.

e) Data Archiving and Retrieval:

1) Archived data files are compressed using user defined deadband. Data files will contain time, name, value, and status for each entry. On-line maintenance and automatic purging of data files must be provided.

2) Data archiving program must be configurable. Data must be capable of being sourced from any like computer on a network.

3) The data retrieval and display window must be configurable and support up to eight variables on the same time/value axis. The ability to have a maximum of nine display windows active must be provided. User selectable colors from a palette of 356 colors must be assignable to any datum. The system must provide time "panning" and on-line "zooming" features. The zoom must provide automatic scaling of the time and value axis.

f) Security:

1) The system must support up to 254 separate security areas. Each tag must be able to be assigned to none, one to three, or all of the security areas. Users with clearance to the appropriate security area can modify the associated tag parameters. The assignment of security areas to tags and user clearances are controlled by the security manager.

2) The system must support the ability to disable rebooting of the computer (soft reboot using <Ctrl><Alt> keys), task switching under WINDOWS, the system menu bar, the system title bar and menu bar. The ability to allow rebooting and task switching must be controlled by the security system such that an authorized user can accomplish either or both functions.

g) General Features:

1) Recipe management capability must be available. It must be configurable, support batch sizing, provide recipe security, and operation tracking functions.

2) Software tools must be available for data access using Dynamic Data Exchange (DDE) client/server functionality and C, C++, Visual Basic and Object Linking and Embedding (OLE) program access to either local or networked real-time database tag data.

3. Services:

a) Training: Available at supplier's site or at client's site. Curriculum offered must include both general and client specific education. Topics covered and demonstrated must include process graphics creation, modification, and distribution; application and communication software setup, problem solving, modification, and trouble shooting.

b) Technical Support: Telephone, 24 hours per day, 365 days per year.

4. Licenses: Two developmental licenses.

5. 1- to 2-year prepaid maintenance contract for all software.

d. Uninterruptible Power Supply (UPS):

1. General:

a) Function: Provides line power conditioning and battery backup for electronic equipment.

b) Type: Ferroresonant.

2. Performance:

a) Capacity (VA): At least 33 percent greater than normal operating load of connected equipment or noted, minimum VA.

whichever is greater.

- b) Regulation: Plus or minus 3 percent.
- c) Total Harmonic Distortion: 5 percent, maximum.
- d) Spike Attenuation: 2,000 to 1.
- e) Operating Environment: 32 to 104 degrees F.
- f) Battery Run-time:
 - 1) 9 to 14 minutes at full load.
 - 2) 25 to 30 minutes at half load.

3. Features:

- a) Audible Noise: 41 to 51 dB online.
- b) Lightning and Surge Protection: ANSI/IEEE C62.41 Category A and Category B.
- c) Safety: UL 1449 listed.

4. Power Interface:

- a) Input Voltage: 96V ac to 138V ac, unless otherwise noted.
- b) Output Voltage: 120V ac.
- c) Output Receptacles: Four integral.

e. Programmable Logic Controller System (mounted in ACP-1):

1. General:

a) Function: Used for process monitoring and control by emulating functions of conventional panel mounted equipment such as relays, timers, counters, current switches, calculation modules, PID controllers, stepping switches, and drum programmers.

b) Type: Microprocessor based device programmable using ladder logic.

c) Parts: Central processing unit (CPU), power supply, local input/output modules, local base (rack) controllers, I/O bases (rack), data highway, hot standby software, and factory assembled interconnecting cables. Provide components required to make a complete and totally operational system. Reference PLC system block diagram in Drawings.

2. Environmental:

a) Temperature: Operating range 32 to 140 degrees F (0 to 60 degrees C); storage range minus 40 to 158 degrees F (0 to 70 degrees C).

b) Humidity: Operating range 5 to 95 percent noncondensing.

c) Vibration: 0.625 at 50 to 500-Hz.

d) Noise: IEC 801, Part 3, Level 3 and Part 4, Level 3; MIL STD-461B.

e) Isolation: User-side to PLC side 1,500V rms.

3. Central Processing Unit (CPU):

a) Type: Microprocessor, 16-bit minimum.

b) Scan Time: Less than 3 ms/K words of relay ladder logic.

c) PLC Communications:

1) Two communication ports.

2) One I/O port.

3) Baud rates supported 1,200, 2,400, 9,600, 19,200.

d) Network Communications: Two Modicon ModBus Plus ports.

e) Instruction Set:

1) Internal Coils: 8,192 minimum.

2) Time-of-Day Clock.

3) Contacts: NO, NC, Pos Trans, Neg Trans.

4) Coils: Normal, latch.

5) Timers: 1.0, 0.1, 0.01 Sec.

6) Counters: Up/Down.

7) Arithmetic (4-Digit):

a. Add, Subtract, Multiply, Divide.

- b. Square Root, Process Square Root, Log, and Anti-log.
- 8) Arithmetic (Double Precision): Add, Subtract, Multiply, Divide.
- 9) Arithmetic (Floating Point):
 - a. Add, Subtract, Multiply, Divide.
 - b. Comp, Square Root, Log, Natural Log, Exponential.
- 10) Trig: Sin, Cos, Tan, Arcsin, Arccos, Arctan.
- 11) Math Conversion: Floating Point to Integer, Integer to Floating Point, Degrees to Radians, Radians to Degrees, Change Sign.
- 12) Move:
 - a. Register to Table, Table to Register, Table to Table, Block Move, Search, First In, First Out.
 - b. Table to Block, Block to Table.
- 13) Subroutines: Jump to Sub, Return.
- 14) Drum Sequencer: Drum, Input Compare.
- 15) Matrix: And, Or, XOR, Complement, and Compare.
- 16) Bit: Bit Modify, Bit Sense, and Bit Rotate.
- 17) Diagnostics: Status.
- 18) Scan Ops: Skip Network(s), Constant Sweep, Single Sweep, and Segment Scheduler.
- 19) PID.
- f) Diagnostics:
 - 1) Indicators: Battery status, PLC status, PLC operation mode, remote I/O communication status.
 - 2) Status Word: With failure status for PLC battery, scan overrun, communications, I/O, special functions.
 - 3) Power Up: PLC checks status of PROMs upon powerup; runs self-diagnostics on power-up; periodically runs self-diagnostics while in RUN mode, halts logic processor and sets outputs to configured state if fatal error is detected.
 - 4) Diagnostic Tables: Tables, displayable by programming computer, that describe nature and location (address) existing faults and errors.
- g) Agency Approvals and Standards:
 - 1) UL listed.
 - 2) CSA certified.
- 4. Random Access Memory (RAM):
 - a) Type: CMOS type.
 - b) Word Size: 16 bits, minimum.
 - c) Battery Backup: Six months, minimum.
 - d) Memory Size: 16 K words of ladder logic memory, 9,999 K words of variable memory, plus required overhead for standard functions.
 - e) Read only memory (ROM) for controller's operating system and diagnostics.
 - f) Memory Protection: Keylock switch.
- 5. Power Supply: One unit for each input/output base assembly:
 - a) Voltage: 120V ac.
 - b) Mounting: Internal to CPU.
- 6. Input/Output: Complete input/output system with a minimum capacity of 8,192 discrete inputs, 8,192 discrete outputs, 1,024 analog inputs, and 1,024 analog outputs.
 - a) Discrete Input Modules:
 - 1) Voltage: 24V dc.
 - 2) Points Per Module: 16, maximum.
 - 3) LED status indicator for each point.
 - 4) Isolation: Between input point and PLC, 1,500 volts

- rms.
- b) Discrete Output Modules:
 - 1) Voltage: 24V dc.
 - 2) Load Rating: 2 amps continuous.
 - 3) Isolation: Between PLC and output point, 1,500 volts
- rms.
- 4) Points Per Module: 16, maximum.
 - 5) LED status indicator for each point.
 - c) Analog Input Modules:
 - 1) Number of Channels: 8.
 - 2) Operating Range:
 - a. 1 to 5V dc.
 - b. 4 to 20 mA dc.
 - 3) Resolution: 12-bit.
 - 4) Accuracy: Plus or minus 0.1 percent.
 - 5) Linearity: Plus or minus 0.05 percent of full scale at 25 degrees C.
 - 6) Update Time: 10 ms for 8 channels.
 - 7) Isolation:
 - a. Channel to Channel: 30V ac continuous.
 - b. Channel to Module: 1,500V ac per module.
 - d) Analog Output Modules:
 - 1) Number of Channels: 4.
 - 2) Operating Range: 4 to 20 mA dc.
 - 3) Resolution: 12-bit.
 - 4) Accuracy: Plus or minus 0.1 percent at 25 degrees C.
 - 5) Update Times: Less than 1 ms, all 4 channels.
 - 6) Isolation:
 - a. Channel to Channel: 1,000V, continuous.
 - b. Channel to Case: 1,000V, continuous.
 - c. Channel to Module: 1,000V, continuous.
7. Communication Network:
- a) Network Interface: Communication to computer subsystem computers via Modicon ModBus.
8. Identification:
- a) Nameplates installed above/below each PLC component (CPU, I/O rack, power supply, etc.).
 - b) Identify configured I/O points as they have been configured (addressed) in the system, as approved by the Engineer.
9. Programming Computer:
- a) Hardware:
 - 1) Type: Portable, 32-bit, IBM compatible personal computer.
 - 2) Processor: Intel 486.
 - 3) Clock Speed: 33 M Hz, minimum.
 - 4) RAM: 4 Mbyte, minimum, expandable to 32 Mbytes, minimum.
 - 5) Floppy Drive: 3-1/2-inch, 1.44-Mbyte diskette drive.
 - 6) Hard Drive: 100-Mbyte, minimum.
 - 7) VGA Display: Suitable for use in low light situations.
 - 8) Serial communications port.
 - 9) Parallel printer port.
 - 10) Battery pack and charger.
 - 11) Carrying case with shoulder strap, storage pockets and space for battery, charger, power cords, and communications cable.
 - 12) One expansion capacity to accept 1/2 slot-AT form factor board.
 - 13) Data Highway Interface Card and Cable: ModBus Plus.
 - 14) Manufacturer: Compaq.

- b) Standard Software:
 - 1) Number of Copies: One.
 - 2) MS-DOS operating system.
 - 3) Microsoft Windows standard software.
 - 4) PLC Programming Software: Taylor Proworx Programming software.
 - 5) Utility Programs: Windows most recent version, WordPerfect most recent version.
- c) Additional Components:
 - 1) Trackball with driver software.
 - a. Diskettes, Two boxes of ten.
- 10. Equipment Groups:
 - a) Equipment Group 1:
 - 1) Components:
 - a. Programming computer.
 - b. PLC system software.
 - c. Database system software.
 - d. PLC programming system software and manuals (system software loaded on programming computer by Contractor prior to delivery).
 - 3) Prerequisite: PLC hardware, software, and I/O database Submittals.
 - b) Equipment Group 2:
 - 1) Components:
 - a. CPU and power supply, quantity = 1.
 - b. I/O base, quantity = 3.
 - c. PLC power supply, quantity = 1.
 - d. base controller module, quantity = 2.
 - e. Analog and discrete I/O modules, quantity = Quantity shown on P&IDs, plus spares.
 - f. Interconnecting data and programming cables, quantity = as required for components shipped.
 - g. Power cable, quantity = as required for components shipped.
 - h. 24V dc power supply, quantity = 1.
 - i. Transmitter simulator, quantity = 1.
 - 2) Location: Office.
 - 3) Prerequisite: PLC hardware, software, and I/O database Submittals.
- 11. Spares:
 - a) Installed Spare Modules:
 - 1) Spare modules defined as completely unused.
 - 2) One Discrete Input Module
 - 3) One Discrete Output Module.
 - 4) One Analog Input Module.
 - 5) One Analog Output Module.
 - b) Unused Slots: In addition to installed spare modules, provide:
 - 1) Minimum of two unused slots.
- f. Printer, Laser:
 - 1. General:
 - a) Type: LaserJet.
 - 2. Features:
 - a) 300 dots per inch.
 - b) Scalable type faces.
 - c) Replaceable toner cartridges.

- d) Eight pages per minute capacity.
- e) Paper input tray with 200 sheets of letter size paper capacity.
- f) Parallel and serial ports.
- g) 120V ac operation.
- 3. Spares and Expendables:
 - a) Provide 500 sheets of 8-1/2 inches x 11 inches, compatible paper.
 - b) Provide 3 spare toner cartridges.

2.3 NAMEPLATES AND TAGS

2.3.1 Panel Nameplates

Enclosure identification located on the enclosure face.

- a. Location and Inscription: As shown.
- b. Materials: Adhesive backed, laminated plastic.
- c. Letters: 1/2-inch black on white background, unless otherwise noted.

2.3.2 Component Nameplates-Panel Face

Component identification located on panel face under or near component.

- a. Location and Inscription: As shown.
- b. Materials: Adhesive backed, laminated plastic.
- c. Letters: 3/16-inch black on white background, unless otherwise noted.

2.3.3 Component Nameplates-Back of Panel

Component identification located on or near component inside of enclosure.

- a. Inscription: Component tag number.
- b. Materials: Adhesive backed, laminated plastic.
- c. Letters: 3/16-inch black on white background, unless otherwise noted.

2.3.4 Service Legends

Component identification nameplate located on face of component.

- a. Inscription: As shown.
- b. Materials: Adhesive backed, laminated plastic.
- c. Letters: 3/16-inch black on white background, unless otherwise noted.

2.3.5 Nametags

Component identification for field devices.

- a. Inscription: Component tag number.
- b. Materials: 16-gauge, Type 304 stainless steel.
- c. Letters: 3/16-inch imposed.
- d. Mounting: Affix to component with 16- or 18-gauge stainless steel wire or stainless steel screws.

2.4 ELECTRICAL REQUIREMENTS

- a. In accordance with Division 16, ELECTRICAL.
- b. I&C and electrical components, terminals, wires, and enclosures: UL recognized or UL listed.
- c. Wires within Enclosures:
 - 1. ac Circuits:
 - a) Type: 300-volt, Type MTW stranded copper.
 - b) Size: For current to be carried, but not less than No. 18-AWG.
 - 2. Analog Signal Circuits:
 - a) Type: 300-volt stranded copper, twisted shielded pairs.
 - b) Size: No. 18-AWG, minimum.
 - 3. Other dc Circuits:
 - a) Type: 300-volt, Type MTW stranded copper.
 - b) Size: No. 18-AWG, minimum.
 - 4. Special Signal Circuits: Use manufacturer's standard cables.
 - 5. Wire Identification: Numbered and tagged at each termination.
 - a) Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.
- d. Wires entering or leaving enclosures, terminate and identify as follows:
 - 1. Analog and discrete signal, terminate at numbered terminal blocks.
 - 2. Special signals, terminated using manufacturer's standard connectors.
 - 3. Identify wiring in accordance with Section 16402, "Interior Distribution System."
- e. Terminal Blocks for Enclosures
 - 1. Quantity:
 - a) Accommodate present and spare indicated needs.
 - b) One wire per terminal, maximum.
 - c) Wire spare and unused panel mounted elements to their panels' terminal blocks.
 - d) Spare Terminals: Provide spare terminals as follows:
 - 1) For installed spare points on used PLC modules.
 - 2) For all points of installed spare (unused) PLC modules.
 - 3) For an additional 32 points. (This represents the use of 16-point modules in two unused slots.)
 - 2. General:
 - a) Connection Type: Screw compression clamp.

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

- 1) Complies with DIN-VDE 0611.
- 2) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
- 3) Guides strands of wire into terminal.
 - b) Compression Clamp:
 - c) Screws: Hardened steel, captive and self-locking.
 - d) Current Bar: Copper or treated brass.
 - e) Insulation:
 - 1) Thermoplastic rated for minus 55 to plus 110 degrees C.
 - 2) Two funnelled shaped inputs to facilitate wire entry.
 - f) Mounting:
 - 1) Standard DIN rail.
 - 2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - 3) End Stops: Minimum of one at each end of rail.
 - g) Wire Preparation: Stripping only permitted.
 - h) Jumpers: Allow jumper installation without loss of space on terminal or rail.
 - i) Marking System:
 - 1) Terminal number shown on both sides of terminal block
 - 2) Allow use of preprinted and field marked tags.
 - 3) Terminal strip numbers shown on end stops.
 - 4) Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.
 - 5) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.
 - j) Test Plugs: Soldered connections for 18 AWG wire.
 - 1) Pin Diameter: 0.079 inch.
 - 2) Quantity: 10.
 - 3) Manufacturer and Product: Entrelec; Type FC2.
3. Terminal Block, General-Purpose:
 - a) Rated Voltage: 600V ac.
 - b) Rated Current: 30 amp.
 - c) Wire Size: 22 to 10 AWG.
 - d) Rated Wire Size: 10-AWG.
 - e) Color: Grey body.
 - f) Spacing: 0.25 inch, maximum.
 - g) Test Sockets: One screw test socket 0.079-inch diameter.
 - h) Manufacturer and Product: Entrelec; Type M4/6.T.
4. Terminal Block, Ground:
 - a) Wire Size: 22 to 12 AWG.
 - b) Rated Wire Size: 12 AWG.
 - c) Color: Green and yellow body.
 - d) Spacing: 0.25 inch, maximum.
 - e) Grounding: Ground terminal blocks electrically grounded to the mounting rail.
 - f) Manufacturer and Product: Entrelec; Type M4/6.P.
5. Terminal Block, Blade Disconnect Switch:
 - a) Rated Voltage: 600V ac.
 - b) Rated Current: 10-amp.
 - c) Wire Size: 22 to 12 AWG.
 - d) Rated Wire Size: 12 AWG.
 - e) Color: Grey body, orange switch.
 - f) Spacing: 0.25 inch, maximum.
 - g) Manufacturer and Product: Entrelec; Type M4/6.SN.T.
6. Terminal Block, Fused, 24V dc:
 - a) Rated Voltage: 600V dc.
 - b) Rated Current: 16-amp.
 - c) Wire Size: 22 to 10 AWG.

- d) Rated Wire Size: 10 AWG.
- e) Color: Grey body.
- f) Fuse: 0.25 inch by 1.25 inch.
- g) Indication: LED diode 24V dc.
- h) Spacing: 0.512 inch, maximum.
- i) Manufacturer and Product: Entrelec; Type M10/13T.SFL.
- 7. Terminal Block, Fused, 120V ac:
 - a) Rated Voltage: 600V ac.
 - b) Rated Current: 16-amp.
 - c) Wire Size: 22 to 10 AWG.
 - d) Rated Wire Size: 10 AWG.
 - e) Color: Grey body.
 - f) Fuse: 0.25 inch by 1.25 inch.
 - g) Indication: Neon Lamp 110V ac.
 - h) Leakage Current: 1.8 mA, maximum.
 - i) Spacing: 0.512 inch, maximum
 - j) Manufacturer and Product: Entrelec; Type M10/13T.SFL.
- 8. Terminal Block, Fused, 120V ac, High Current:
 - a) Rated Voltage: 600V ac.
 - b) Rated Current: 35 amps.
 - c) Wire Size: 18 to 8 AWG.
 - d) Rated Wire Size: 8 AWG.
 - e) Color: Grey.
 - f) Fuse: 13/32 inch by 1.5 inch.
 - g) Spacing: 0.95 inch, maximum.
 - h) Manufacturer and Product: Entrelec; Type MB10/24.SF.
- f. Wiring of Spare I/O Points and Spare I/O Modules: Wire all installed spare I/O points to terminal blocks for future use.
- g. Grounding of Enclosures:
 - 1. Furnish isolated copper grounding bus for signal and shield ground connections.
 - 2. Ground bus grounded at a common signal ground point in accordance with National Electrical Code requirements.
 - 3. Single Point Ground for Each Analog Loop:
 - a) Locate at dc power supply for loop.
 - b) Use to ground wire shields for loop.
 - c) Group and connect shields in following locations: ACP-1.
 - 4. Ground terminal block rails to ground bus.
- h. Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another. Do not wire in series instruments on different panels, cabinets, or enclosures.
- i. Power Distribution within Panel:
 - 1. Feeder Circuits:
 - a) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
 - b) Make provisions for feeder circuit conduit entry.
 - c) Furnish terminal board for termination of wires.
 - 2. Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
 - a) Locate to provide clear view of and access to breakers when door is open.
 - b) Breaker sizes: Coordinate such that fault in branch

circuit will blow only branch breaker but not trip the main breaker.

- 1) Branch Circuit Breaker: 15 amps at 250V ac.
- c) Breaker Manufacturers and Products: Square D, Type QO.
3. Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:
 - a) Devices on Single Circuit: 20, maximum.
 - b) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
 - c) Branch Circuit Loading: 12 amperes continuous, maximum.
 - d) Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.
 - e) Provide 120-volt ac plug mold for panel components with line cords.

j. Signal Distribution:

1. Within Panels: 4 to 20 mA dc signals may be distributed as 1 to 5V dc.
2. Outside Panels: Isolated 4 to 20 mA dc only.
3. All signal wiring twisted in shielded pairs.

k. Signal Switching:

1. Use dry circuit type relays or switches.
2. No interruption of 4 to 20 mA loops during switching.
3. Switching Transients in Associated Signal Circuit:
 - a) 4 to 20 mA dc Signals: 0.2 mA, maximum.
 - b) 1 to 5V dc Signals: 0.05V, maximum.

l. Relays

1. General:

- a) Relay Mounting: Plug-in type socket.
- b) Relay Enclosure: Furnish dust cover.
- c) Socket Type: Screw terminal interface with wiring.
- d) Socket Mounting: Rail.
- e) Provide holddown clips.

2. Signal Switching Relay:

- a) Type: Dry circuit.
- b) Contact Arrangement: 2 Form C contacts.
- c) Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
- d) Contact Material: Gold or silver.
- e) Coil Voltage: As noted or shown.
- f) Coil Power: 0.9 watts (dc), 1.2VA (ac).
- g) Expected Mechanical Life: 10,000,000 operations.
- h) Expected Electrical Life at Rated Load: 100,000 operations.
- i) Indication Type: Neon or LED indicator lamp.
- j) Seal Type: Hermetically sealed case.

3. Control Circuit Switching Relay, Nonlatching:

- a) Type: Compact general-purpose plug-in.
- b) Contact Arrangement: 3 Form C contacts.
- c) Contact Rating: 10A at 28V dc or 240V ac.
- d) Contact Material: Silver cadmium oxide alloy.
- e) Coil Voltage: As noted or shown.
- f) Coil Power: 1.8 watts (dc), 2.7VA (ac).
- g) Expected Mechanical Life: 10,000,000 operations.
- h) Expected Electrical Life at Rated Load: 100,000 operations.

- i) Indication Type: Neon or LED indicator lamp.
- 4. Control Circuit Switching Relay, Latching:
 - a) Type: Dual coil mechanical latching relay.
 - b) Contact Arrangement: 2 Form C contacts.
 - c) Contact Rating: 10A at 28V dc or 120V ac.
 - d) Contact Material: Silver cadmium oxide alloy.
 - e) Coil Voltage: As noted or shown.
 - f) Coil Power: 2.7 watts (dc), 5.3VA (ac).
 - g) Expected Mechanical Life: 500,000 operations.
 - h) Expected Electrical Life at Rated Load: 50,000 operations.
- 5. Control Circuit Switching Relay, Time Delay:
 - a) Type: Adjustable time delay relay.
 - b) Contact Arrangement: 2 Form C contacts.
 - c) Contact Rating: 10A at 28V dc or 240V ac.
 - 1) Contact Material: Silver cadmium oxide alloy.
 - d) Coil Voltage: As noted or shown.
 - e) Operating Temperature: Minus 10 to 55 degrees C.
 - f) Repeatability: Plus or minus 2 percent.
 - g) Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent of range.
 - h) Time Delay Set Point: As noted or shown.
 - i) Mode of Operation: As noted or shown.
 - j) Adjustment Type: Integral potentiometer with knob external to dust cover.
- m. Power Supplies:
 - 1. Furnish to power instruments requiring external dc power, including two-wire transmitters, dc relays, PLCs, annunciators, and indicating lights.
 - 2. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
 - 3. Provide output over voltage and over current protective devices to:
 - a) Protect instruments from damage due to power supply failure.
 - b) Protect power supply from damage due to external failure.
 - 4. Enclosures: NEMA 1 in accordance with NEMA 250.
 - 5. Mount such that dissipated heat does not adversely affect other components.
 - 6. Fuses: For each dc supply line to each individual two-wire transmitter.
 - a) Type: Indicating.
 - b) Mount so fuses can be easily seen and replaced.
- n. Internal Panel Lights for ACP-1
 - 1. Type: Switched 100-watt incandescent back-of-panel lights.
 - 2. Quantity: One light for every 4 feet of panel width.
 - 3. Mounting: Inside and in the top of back-of-panel area.
 - 4. Protective metal shield for lights.
- o. Service Outlets for ACP-1
 - 1. Type: Three-wire, 120-volt, 15-ampere, duplex receptacles.
 - 2. Quantity:
 - a) For panels 4 feet wide and smaller: One.
 - b) For panels wider than 4 feet: One for every 4 feet of

panel width, two minimum per panel.

3. Mounting: Evenly spaced along back-of-panel area.

2.5 ELECTRICAL TRANSIENT PROTECTION

a. General:

1. Function: Protect elements of PICS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems.
2. Implementation: Provide, install, coordinate, and inspect grounding of surge suppressors at:
 - a) Connection of ac power to PICS equipment including panels, consoles assemblies, and field mounted analog transmitters and receivers.
 - b) At the field and panel, console, or assembly connection of each signal circuit.
3. Construction: First-stage high energy metal oxide varistor and second-stage bipolar silicon avalanche device separated by series impedance. Includes grounding wire, stud, or terminal.
4. Response: 5 nanoseconds maximum.
5. Recovery: Automatic.
6. Temperature Range: Minus 20 degrees C to plus 85 degrees C.

b. Suppressors on 120V ac Power Supply Connections:

1. Occurrences: Tested and rated for a minimum of 50 occurrences of IEEE 587 Category B test waveform.
2. First-Stage Clamping Voltage: 350 volts or less.
3. Second-Stage Clamping Voltage: 210 volts or less.
4. Continuous Operation: Power supplies for one four-wire transmitter or receiver: 5 amps minimum at 130V ac. All other applications: 30 amps minimum at 130V ac.

c. Suppressors on Analog Signal Lines:

1. Test Waveform: Linear 8 microsecond rise in current from 0 amps to a peak current value followed by an exponential decay of current reaching one half the peak value in 20 microseconds.
2. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test waveform.
 - a) dc Clamping Voltage: 20 to 40 percent above operating voltage for circuit.
 - b) dc Clamping Voltage Tolerance: Less than plus or minus 10 percent.
 - c) Maximum Loop Resistance: 18 ohms per conductor.

d. Physical Characteristics:

1. Mounted in Enclosures: Encapsulated inflame retardant epoxy.
2. For Analog Signals Lines: EDCO PC-642 or SRA-64 series.
3. For 120V ac Lines: EDCO HSP-121.
4. Field Mounted at Two-Wire Instruments: Encapsulated in stainless steel pipe nipples. EDCO SS64 series.
5. Field Mounted at Four-Wire Instruments: With 120V ac outlet, ac circuit breaker, and 10-ohm resistors on signal lines, all in enclosure.
 - a) Enclosure: NEMA 4X fiberglass or Type 316 stainless steel with door.

1) Maximum Size: 12 inches by 12 inches by 8 inches deep.

e. Locations: Locate surge suppressors on the following locations:

1. 120V ac Power Supply Connections at ACP-1.

f. Installation and Grounding of Suppressors: As shown. See Surge Suppressor Installation Details. Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 16, ELECTRICAL.

2.6 TEST EQUIPMENT AND TOOLS

<u>Item</u>	<u>Qty.</u>	<u>Options and Model</u>
Digital multimeter	2	Fluke Model 87 YEL with carrying case Model C20
Pressure calibrator	2	Fluke model 702 with battery pack model BP7217 and carrying case Model C789
Pressure module	2	Fluke Model 700P05
Small tool kit	1	Kit of instrument maintenance tools in soft, zipper case; Jensen Tools Model JTK-47CG
Terminal kit	1	Kit of solderless terminals and cable ties; Jensen Tools Model 23B210

2.7 SPARE PARTS

a. General:

1. Provide spare parts as per the following table.
2. Provide additional spare parts as specified under individual component specifications.

<u>Description</u>	<u>Percent of Each Type and Size Used</u>	<u>No Less Than</u>
dc power supplies	20	1
Fuses	20	5
Relays (including time delay relays)	20 of each type	3 of each type
Terminal Blocks	10	10
PLC CPU	NA	1
PLC Power Supply	NA	1 each of each type and size used
PLC Local Rack Controller	NA	1
PLC Data Highway Card	NA	1

<u>Description</u>	<u>Percent of Each Type and Size Used</u>		<u>No Less Than</u>
PLC Discrete Input Module (Noninstalled)	NA		1
PLC Discrete Output Module (Noninstalled)	NA		1
PLC Analog Input Module (Noninstalled)	NA		1
PLC Analog Output Module (Noninstalled)	NA		1

2.8 EXPENDABLES

a. General:

1. Provide expendables as listed below.
2. Provide additional expendables as specified under individual component specifications.

Item

Quality

Corrosion-inhibiting
vapor capsules

Manufacturer's recommended
2-year supply

2.9 FABRICATION

a. General:

1. Panels with external dimensions and instruments arrangement as shown on Drawings.
2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code, state and local codes, NEMA, ANSI, UL, and ICECA.
3. Fabricate panels, install instruments, wire, and plumb, at the PICS factory.
4. Electrical Work: In accordance with Division 16, ELECTRICAL.

- b. Factory Assembly: Assemble panels at the manufacturer's factory. No fabrication other than correction of minor defects or minor transit damage shall be done on panels at site.

c. Wiring Within ACP-1

1. Restrain by plastic ties or ducts or metal raceways.
2. Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
3. Arrange wiring neatly, cut to proper length, and remove surplus wire.
4. Abrasion protection for wire bundles which pass through holes or across edges of sheet metal.
5. Connections to Screw Type Terminals:

- a) Locking-fork-tongue or ring-tongue lugs.
- b) Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
- c) Wires terminated in a crimp lug, maximum of one.
- d) Lugs installed on a screw terminal, maximum of two.
- 6. Connections to Compression Clamp Type Terminals:
 - a) Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
 - b) Wires installed in a compression screw and clamp, maximum of one.
- 7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
- 8. Terminate 24V dc and analog signal circuits on separate terminal block from ac circuit terminal blocks.
- 9. Do not mix analog and dc circuit wiring with power and control circuit wiring in bundles, conduits, raceways, or any other conveyance. Separate analog and dc circuits by at least 6 inches from ac power and control wiring. Crossover points must be at 90 degree angles.
- 10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.
- 11. Plastic wire ducts fill: Do not exceed manufacturer's recommendation.
- d. Temperature Control:
 - 1. Freestanding Panels:
 - a) Nonventilated Panels: Size to adequately dissipate heat from equipment mounted inside panel or on panel.
 - b) Ventilated Panels:
 - 1) Furnish with louvers and forced ventilation as required to prevent temperature buildup from equipment mounted inside panel or on panel.
 - 2) For panels with backs against wall, furnish louvers on top and bottom of panel sides.
 - 3) For panels without backs against wall, furnish louvers on top and bottom of panel back.
 - 4) Louver Construction: Stamped sheet metal.
 - 5) Ventilation Fans:
 - a. Furnish where required to provide adequate cooling.
 - b. Create positive internal pressure within panel.
 - c. Fan Motor Power: 120 volt, 60-Hz ac, thermostatically controlled.
 - 6) Air Filters: Washable aluminum, Hoffman Series A-FLT.
 - 2. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.
 - 3. Space Heaters:
 - a) Thermostatically controlled to maintain internal panel temperatures above dew point.
 - b) Required for following panels: ACP-1.
- e. Freestanding Panel Construction ACP-1:
 - 1. Materials: Sheet steel, unless otherwise shown on Drawings with minimum thickness of 10-gauge, unless otherwise noted.
 - 2. Panel Fronts:
 - a) Fabricated from a single piece of sheet steel, unless otherwise shown on Drawings.

- b) No seams or bolt heads visible when viewed from front.
- c) Panel Cutouts: Smoothly finished with rounded edges.
- d) Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

3. Internal Framework:

- a) Structural steel for instrument support and panel bracing.
- b) Permit panel lifting without racking or distortion.

4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.

5. Adjacent Panels: Securely bolted together so front faces are parallel.

6. Doors: Full height, fully gasketed access doors where shown on Drawings.

- a) Latches: Three-point, Southco Type 44.
- b) Handles: "D" ring, foldable type.
- c) Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.
- d) Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.
- e) Front and Side Access Doors: As shown on Drawings.

f. Nonfreestanding Panel Construction Vault Control Panels:

- 1. Enclosure Type: As shown on Drawings.
- 2. Metal Thickness: 14-gauge, minimum.
- 3. Doors:
 - a) Rubber-gasketed with continuous hinge.
 - b) Stainless steel lockable quick-release clamps.

g. Factory Finishing:

1. Enclosures:

- a) Stainless Steel and Aluminum: Not painted.
- b) Steel Panels:
 - 1) Sand panel and remove mill scale, rust, grease, and oil.
 - 2) Fill imperfections and sand smooth.
 - 3) Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
 - 4) Sand surfaces lightly between coats.
 - 5) Dry Film Thickness: 3 mils, minimum.
 - 6) Color: Gray (match existing drives).

2. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.

2.10 CORROSION PROTECTION

Corrosion-Inhibiting Vapor Capsule.

2.11 SOURCE QUALITY CONTROL

- a. Scope: Inspect and test entire PICS to ensure it is ready for shipment, installation, and operation.
- b. Location: Manufacturer's factory or Engineer approved staging site.

- c. Test: Exercise and test all functions.
- d. Temporary PLC software configuring to allow PLC testing.

PART 3 EXECUTION

3.1 EXAMINATION

- a. For equipment not provided by PICS, but that directly interfaces with the PICS, verify the following conditions:
 - 1. Proper installation.
 - 2. Calibration and adjustment of positioners and I/P transducers.
 - 3. Correct control action.
 - 4. Switch settings and dead bands.
 - 5. Opening and closing speeds and travel stops.
 - 6. Input and output signals, including the DCS at the main water reclamation facility.

3.2 INSTALLATION

- a. Material and Equipment Installation: Retain a copy of manufacturers' instructions at site, available for review at all times.
- b. Electrical Wiring: As specified in Division 16, ELECTRICAL.
- c. Mechanical Systems:
 - 1. Enclosure Lifting Rings: Remove rings following installation and plug holes.
- d. Data Highway/DCS Interface: Coordinate and provide connection of Data Highway (provided under this Contract).
- e. Removal or Relocation of Materials and Equipment:
 - 1. Remove from site materials that were part of the existing facility but are no longer used, unless otherwise directed by Engineer to deliver to Owner.
 - 2. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.

3.3 FIELD FINISHING

- a. Refer to Section 09900, "Paints and Coatings."

3.4 FIELD QUALITY CONTROL

- a. Startup and Testing Team
 - 1. Thoroughly inspect installation, termination, and adjustment for components and systems.
 - 2. Complete onsite tests.
 - 3. Complete onsite training.
 - 4. Provide startup assistance.
- b. Phase 1 ORT: Performed by PICS Subcontractor to test and document that PICS, excluding Engineer provided PLC and Computer

applications software, is ready for operation. For PICS Subsystems for which Engineer provides applications software, provide sufficient temporary software configuring to allow testing of these subsystems.

1. Loop/Component Inspections and Tests:

- a) Check PICS for proper installation, calibration, and adjustment on a loop-by-loop and component-by-component basis.
- b) Provide space on forms for signoff by PICS Subcontractor.
- c) Use loop status report to organize and track inspection, adjustment, and calibration of each loop and include the following:

- 1) Project name.
- 2) Loop number.
- 3) Tag number for each component.
- 4) Checkoffs/Signoffs for Each Component:
- 5) Tag/identification.
 - o Installation.
 - o Termination wiring.
 - o Termination tubing.
 - o Calibration/adjustment.
- 6) Checkoffs/Signoffs for the Loop:
 - o Panel interface terminations.
 - o I/O interface terminations with PLCs.
 - o I/O Signals for PLCs are Operational:

Received/sent, processed, adjusted.

- o Total loop operational.
- o Space for comments.

7) Component calibration sheet for each component (except simple hand switches, lights, gauges, and similar items) and each PLC I/O module and include the following:

- o Project name.
- o Loop number.
- o Component tag number or I/O module number.
- o Component code number for elements.
- o Manufacturer.
- o Model number/serial number.
- o Summary of Functional Requirements, for Example:
 - Indicators and recorders, scale and chart ranges.
 - Transmitters/converters, input and output ranges.
 - Computing elements' function.
 - Controllers, action (direct/reverse) and control

modes (P&ID).

- Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
- I/O Modules: Input or output.
- o Calibrations, for Example, but not Limited to:
 - Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - Discrete Devices: Actual trip points and reset points.
 - Controllers: Mode settings (P&ID).
 - I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
- o Space for comments.

8) Maintain loop status reports, valve adjustment sheets, and component calibration sheets at site and make them available to Engineer at all time.

9) These inspections and tests will be spot checked by Engineer.

- 10) Engineer reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of ORT. Correct deficiencies found.
 2. Phase 2 ORT: Combined effort between PICS subcontractor and Engineer to confirm the PICS, including applications software, is ready for operation.
 - o Prerequisite: Completion of Phase 1 ORT.
 - o Joint test with Engineer. Repeat of Engineer's application software tests, except using real field sensors and equipment. Plant interlocking and communications with PLCs and Host Computers tested o
 - o n loop-by-loop basis.
 - o Test procedures provided by Engineer based on Phase 1 ORT and on Engineer's application software tests.
- c. Performance Acceptance Tests (PAT): These are the activities that refer to as Performance Testing.
1. General:
 - a) Test all PICS elements to demonstrate that PICS satisfies all requirements.
 - b) Test Format: Cause and effect.
 - 1) Person conducting test initiates an input (cause).
 - 2) Specific test requirement is satisfied if correct result (effect) occurs.
 - c) Procedures, Forms, and Checklists:
 - 1) Conduct tests in accordance with, and documented on, Engineer accepted procedures, forms, and checklists.
 - 2) Describe each test item to be performed.
 - 3) Have space after each test item description for sign off by appropriate party after satisfactory completion.
 - d) Required Test Documentation: Test procedures, forms, and checklists. All signed by Engineer and Contractor.
 - e) Conducting Tests:
 - 1) Provide special testing materials, equipment, and software.
 - 2) Wherever possible, perform tests using actual process variables, equipment, and data.
 - 3) If it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation.
 - 4) Define simulation techniques in test procedures.
 - f) Coordinate PICS testing with Owner and affected Subcontractors.
 2. Test Requirements:
 - a) Once facility has been started up and is operating, perform jointly with Engineer a PAT on complete PICS to demonstrate that it is operating as required. Demonstrate each required function on a paragraph-by-paragraph and loop-by-loop basis.
 - b) Perform local and manual tests for each loop before proceeding to remote and automatic modes.
 - c) Where possible, verify test results using visual confirmation of process equipment and actual process variable.. Unless otherwise directed, exercise and observe devices supplied by others, as needed to verify correct signals to and from such devices and to confirm overall system functionality. Test verification by means of disconnecting wires or measuring signal levels is acceptable only where direct operation of plant equipment is not possible.

d) Make updated versions of documentation required for PAT available to Engineer at site, both before and during tests.

e) Make one copy of O&M Manual available to Engineer at the site both before and during testing.

3.5 TRAINING

3.5.1 General

- a. Provide an integrated training program to meet specific needs of Owner's personnel.
- b. Include training sessions, classroom and field, for managers, engineers, operators, and maintenance personnel.
- c. Provide instruction on two working shift(s) as needed to accommodate the Owner's personnel schedule.
- d. Owner reserves the right to make and reuse video tapes of training sessions.

3.5.2 Operations and Maintenance Training

- a. Include a review of O&M manuals and survey of spares, expendables, and test equipment.
- b. Use equipment similar to that provided or currently owned by Owner.
- c. Provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics or instrumentation.

3.5.3 Operations Training

- a. Training Session Duration: One 8-hour instructor day, not including travel time.
- b. Number of Training Sessions: One.
- c. Location: Site.
- d. Content: Conduct training on loop-by-loop basis.
 1. Loop Functions: Understanding of loop functions, including interlocks for each loop.
 2. Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 3. Interfaces with other control systems.

3.5.4 Maintenance Training

- a. Training Session Duration: One 8-hour instructor day.
- b. Number of Training Sessions: One.
- c. Location: Project site.

- d. Content: Provide training for each type of component and function provided.

1. Loop Functions: Understanding details of each loop and how they function.
2. Component calibration.
3. Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
4. Troubleshooting and diagnosis for components.
5. Replacing lamps, chart paper, fuses.
6. Component removal and replacement.
7. Periodic maintenance.
8. PLC hardware.

3.6 CLEANING/ADJUSTING

- a. Repair affected surfaces to conform to type, quality, and finish of surrounding surface.
- b. Cleaning:
 1. Prior to closing system using tubing, clear tubing of interior moisture and debris.
 2. Upon completion of Work, remove materials, scraps, and debris from interior and exterior of equipment.

3.7 PROTECTION

- a. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.
- b. Periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules just prior to Final Payment and Acceptance.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing Apparatus

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

1.2 RELATED REQUIREMENTS

This section applies to Division 2, "Site Work"; Division 11, "Equipment"; Division 13, "Special Construction"; and all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening unless indicated otherwise elsewhere in these specifications. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a

regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the NTR. Replace damaged or defective items.

1.5 SAFETY REQUIREMENTS

1.5.1 Equipment Safety

Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.5.2 Warning Sign

Provide a permanent placard or sign at the entrance to confined spaces contained in the equipment. The sign shall warn personnel not to enter the space until the atmosphere inside has been tested and systems have been de-energized.

1.5.3 Lockout of Energy Sources

Provide appropriate lockout devices for energy isolating valves and for machines or other equipment to prevent unexpected start-up or release of stored electrical, mechanical, hydraulic, pneumatic, thermal, chemical, or other energy in accordance with 29 CFR 1910.147. Lockout devices for valves shall provide a means of attachment to which, or through which, a lock can be affixed or shall have a locking mechanism built into it so that the valve cannot be moved from the lockout position until the lock is removed. Electrical isolation of machines or other equipment shall be in accordance with requirements of DIVISION 16 "Electrical."

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under

Section 16402, "Interior Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402, "Interior Distribution System."

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness

of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, submit certifications that the manufacturer's standard factory painting system conforms to the heat resistance requirement in addition to other certifications.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.
- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 15060

PROCESS PIPING

03/97

PART 1 GENERAL

1.1 WORK INCLUDED

This section covers the work necessary to furnish and install process piping, complete. Process piping includes copper piping inside the extraction well vaults, double-walled HDPE yard piping from the extraction wells to the groundwater treatment plant building, PVC and stainless steel process water piping inside the building, PVC piping for the effluent from the treatment plant to the elevated water storage tank, and from the water storage tank to the river discharge location. Copper piping is also used for instrument air and the condensate and refrigerant lines.

1.2 SUBMITTALS

Submit the following as part of the Work Plan in accordance with Section C, Part 7 of the Basic Contract.

1.2.1 SD-02, Manufacturer's Catalog Data

- a. Pipe schedules G
- b. Piping support systems G
- c. Double-walled HDPE pipe systems G

1.2.2 SD-04, Drawings

- a. Piping layout drawings G

1.2.2.1 Layout Drawings

Detailed mechanical drawings showing piping layouts and elevations, fitting and valve locations, and interfaces with equipment items. For double-walled HDPE pipe systems, include drawings and details of carrier pipe terminations, leak-detection monitoring ports, and interfaces with other piping materials (e.g., copper and PVC pipe in the well vaults and treatment building). Submit details of typical fittings including centralizers, force transfer couplings, cleanouts, etc.

1.2.3 SD-08, Statements

- a. Design calculations
- b. Resin certification

1.2.3.1 Design Calculations

Where piping diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design process piping in accordance with ASME B31.3-93, and building service piping in accordance with ASME B31.9-88.

1.2.3.2 Resin Certification

The double-walled HDPE piping systems supplier shall submit certification that the resin used to make the HDPE pipe meets the specifications.

1.2.4 SD-12, Field Test Reports

- a. Field testing for pressure and leakage testing

1.3 STANDARD PRODUCTS

Piping materials shall be the standard products of a manufacturer regularly engaged in the manufacture of piping products and shall essentially duplicate material that has been in satisfactory operation in similar applications since January 1992. Piping of the same type shall be the product of one manufacturer. Double-walled HDPE piping systems shall be shop-fabricated and tested, and installed by a manufacturer who has a minimum of 5 years experience fabricating and installing double-walled HDPE piping systems.

1.4 DELIVERY, STORAGE, AND HANDLING

- a. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
- b. Threaded or socket welding ends: Fit with metal, wood, or plastic plugs or caps.
- c. Linings and coatings: Prevent excessive drying.
- d. Cold weather storage: Locate products to prevent them from freezing to the ground.
- e. Handling: Use heavy canvas or nylon slings to lift pipe and fittings during unloading, storage, and installation operations.
- f. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, including subfreezing temperatures, precipitation, and high winds. Store materials susceptible to damage by sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on the ground.
- g. Additional Requirements for Double-Walled HDPE Pipe: Pipe ends shall be sealed to prevent water and dirt from entering the pipe. If pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's/suppliers recommendations. The handling of pipe should be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment. Segments of pipe having cuts or gouges in excess of 20 percent of the wall thickness shall not be used.

1.5 MANUFACTURER'S SERVICES

The double-walled HDPE piping system's manufacturer shall provide a factory authorized representative for technical assistance for training prior to pipe installation, and onsite installation assistance during installation.

The cost of this technical assistance shall be borne by the contractor. Factory assistance shall be as follows, excluding travel time.

- a. Three (3) person-days for pipe installation assistance and training on field fusion equipment.
- b. One (1) person-day during hydrostatic testing of the piping system, and to complete Manufacturer's Certificate of Proper Installation.

PART 2 PRODUCTS

2.1 PIPING FOR PROCESS WATER

All piping shall be pressure rated for 150 psig. Carrier pipe in double-walled HDPE piping systems shall be SDR 11, rated at 160 psig. See attached piping schedule at end of this section for piping types, sizes, and descriptions.

2.2 PIPING FOR PROCESS AIR

All piping shall be rated for 175 psig. See attached piping schedule at end of this section for piping types, sizes, and descriptions.

2.3 JOINTS

2.3.1 Grooved End System

- a. Rigid, except where joints are used to correct misalignment, to provide flexibility, or where shown, furnish flexible type.
- b. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

2.3.2 Flanged Joints

- a. Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.
- b. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

2.3.3 Threaded Joints

NPT taper pipe threads in accordance with ANSI B1.20.1-83.

2.3.4 Thrust Tie-Rod Assemblies

NFPA 24-92; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

2.3.5 Mechanical Joint Anchor Gland Follower

- a. Ductile iron anchor type, wedge action, with breakoff tightening bolts.
- b. Manufacturer and Product: EBAA Iron Inc.; Megalug.

2.3.6 Flexible Mechanical Compression Joint Coupling

- a. Stainless steel, ASTM A276-94, Type 305 bands.
- b. Manufacturers:
 1. Pipeline Products Corp.
 2. Ferno Joint Sealer Co.
 3. Or equal.

2.3.7 Mechanical Connections

Mechanical connections of the high density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:

- a. A polyethylene stub end thermally butt-fused to the end of the pipe.
- b. ASTM A240-94, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1-89 Standard. Insulating flanges shall be used where shown.
- c. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Retorque the nuts after 4 hours.
- d. Gaskets as specified on Data Sheet.

2.4 COUPLINGS

Provide flexible couplings at connections to all equipment items including but not limited to pumps and compressors.

PART 3 EXECUTION

3.1 PREPARATION

- a. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.
- b. Damaged coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.2 INSTALLATION

- a. Installation of piping, including materials and workmanship shall be in accordance with the BOCA 1993 plumbing code.
- b. Join pipes and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
- c. Remove foreign objects prior to assembly and installation.
- d. Exposed piping shall run parallel to vertical building or column lines and perpendicular to floor, unless shown otherwise.

- e. Flow measuring devices shall be installed on straight lengths of pipe, or per manufacturer's recommendations, for accurate flow measurement.
- f. Group piping at common elevations, wherever practical. Install piping to conserve building space and not interfere with use of space or other work.
- g. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection. Install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.
- h. Unions or flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.
- i. HDPE pipe placement
 - 1. Double-walled piping systems shall be prefabricated prior to shipment to the jobsite. No on-site fabrication or alterations to the pipe, fittings, or system shall be allowed without the express written consent of the NTR.
 - 2. Lay pipe snaking from one side of trench to other.
 - 3. Do not lay pipe when temperature is below 40 degrees F, or above 90 degrees F when exposed to direct sunlight.
 - 4. Shield ends to be joined from direct sunlight prior to and during the laying operation.
 - 5. Sections of polyethylene pipe shall be joined into continuous lengths on the jobsite following the guidelines of ASTM D 2657, using simultaneous butt fusion as the method of joining the dual contained piping system. The pipe shall have 1/2 inch to 1 inch of the carrier pipe extending out past the containment pipe to test the alignment and test for movement. No movement at the carrier pipe is acceptable prior to welding.
 - 6. Double-walled piping systems supplier shall approve all fusion equipment used for the containment system. The butt fusion equipment shall be capable of meeting all normal butt fusion requirements: Alignment, heating, trimming, and fusion pressure.
- j. Piping clearance:
 - 1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - 2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inches, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
 - 3. From Adjacent Work: Minimum 6 inches from nearest extremity of completed piping system including flanges, valve bodies or

mechanisms, insulation, or hanger/support systems.

4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.

5. Head room in front of openings, doors, and windows shall not be less than the top of the opening.

6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.

7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

k. Flanged Joints:

1. Install perpendicular to pipe centerline.

2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.

3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.

5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

l. Threaded and Coupled Joints:

1. Conform with ANSI B1.20.1-83.

2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.

3. Countersink pipe ends, ream and clean chips and burrs after threading.

4. Make connections with not more than three threads exposed.

5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

m. Soldered Joints:

1. Use only solder specified for particular service.

2. Cut pipe ends square and remove fins and burrs.

3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.

4. Wipe excess solder from exterior of joint before hardened.

5. Before soldering, remove stems and washers from solder joint valves.

n. Couplings:

1. General:

- a) Install in accordance with manufacturer's written instructions.
- b) Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
- c) Do not remove pipe coating. If damaged, repair before joint is made.

2. Application:

- a) Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
- b) Nonmetallic Piping Systems: Teflon bellows connector.
- c) Concrete Encased Couplings: Sleeve type coupling.
- d) Corrosive Service Piping: Elastomer bellows connector.

o. Service Saddle Applications:

1. Ferrous Metal Piping (except stainless steel): Double-strap iron.
2. Plastic Piping: Nylon-coated iron.

p. PVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

q. High Density Polyethylene Piping:

1. Join pipes, fittings, and flange connections by means of thermal butt-fusion.
2. Butt-fusion shall be performed in accordance with the pipe manufacturer's recommendations as to equipment and technique.
3. Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the polyethylene pipe at the flanged joint and the rigid structures is possible.

3.3 LABELS AND FLOW DIRECTION ARROWS

All piping shall be labeled. Labels shall contain black lettering with yellow background. Labels shall indicate pipe identification as shown on the drawings and flow direction. Labels, lettering size, and color shall conform to ANSI A13.1.

3.4 HEAT TRACING

Refer to Section 16050, "Basic Electrical Materials and Methods," for specifications on heat tracing for galvanized steel pipe in extraction well vaults, and carbon steel pipe on the elevated storage tank.

3.5 INSULATION

- a. Above ground piping outside of the treatment system building shall be provided with an appropriate layer of insulation. Piping in the well vaults shall be included in this category of above ground piping outside of the treatment system building. Flanges, valves, couplings and any other elements in the outside piping lines also shall be appropriately insulated.
- b. Insulation shall be UL rated, pre-formed, sectional, rigid fiberglass with factory applied, vinyl-coated and embossed barrier jacket with pressure-sensitive, self-sealing flap. Provide matching pressure-sensitive butt strips for sealing circumferential joints.
- c. Provide premolded insulation or mitered segments around fittings. Insulation shall be wired-in-place and finished with a thin coat of insulating cement, or wrapped with soft fiberglass insulation inserts covered with pre-molded PVC fitting covers. Secure cover and wrap throat and seams with matching PVC tape.
- d. Provide insulation inserts between piping and hangar or support.
- e. Provide 0.016-inch thick aluminum jacket to cover piping and insulation. Provide pre-formed aluminum jackets over fittings.
- f. Hold jacket in place by continuous friction type joint, providing positive weatherproof seal over entire length of jacket.
- g. Insulation thickness for pipes shall be 1.5-inches (minimum) for 2.5-diameter pipes and smaller, and 2-inches (minimum) for 3-inch diameter pipes and larger.

3.6 PENETRATIONS AND PIPE SLEEVES

- a. Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, or partitions.
- b. Steel pipe sleeves: Provide 3/16-inch minimum thickness steel pipe.
- c. Seep ring:
 1. 3/16-inch minimum thickness center steel flange for water stoppage on sleeves in exterior walls.

2. Outside diameter: 3 inches greater than pipe sleeve outside diameter.
3. Continuously fillet weld on each side all around.
- d. Modular mechanical seal: Provide interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening. Assemble interconnected rubber links with ASTM A276-94, Type 316 stainless steel bolts, nuts, and pressure plates. Size according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening.

3.7 PIPING SUPPORT SYSTEMS

- a. Piping shall be supported, in general as described hereinafter. The contractor shall select and design all piping support systems with the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water. Provide additional supports at the concentrated loads in piping between supports, such as flanged valves.
- b. Pipe supports have been intentionally not shown on the drawings. The contractor is completely responsible for designing the pipe support system complete.
- c. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment. A pipe support shall be installed within one pipe diameter of couplings and each pipe fitting or in-line device such as a valve or meter.
- d. All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports shall not be installed in equipment access areas.
- e. Vertical piping shall be supported at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.
- f. Horizontal piping shall be supported as follows:

Maximum Spacing (feet)										
Nominal Pipe Size (inches)	<1	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Pipe Spacing (ft)	6	7	8	8	9	10	11	12	13	14
Steel Pipe Spacing (ft)	6	8	8	8	8	10	10	10	10	12

PVC piping: Maximum support spacing shall be as recommended by manufacturer for this intended service.

3.8 CLEANOUTS

Provide cleanouts for HDPE yard piping at every bend and at 200-foot intervals on straight piping runs.

3.9 VENTS AND DRAINS

Install vents and drains at high and low points in piping. All vents and drains may not be shown on completed drawings.

3.10 CLEANING

- a. Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.
- b. Blow clean of loose debris instrument air lines with compressed air at 4,000 fpm; do not flush with water.
- c. Insert cone strainers in flushing connections to attached equipment and leave in place until cleaning is complete.
- d. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.11 PASSIVATION

All stainless steel piping systems that will be used for conveyance of hydrogen peroxide shall be cleaned and passivated by the method indicated in this section prior to being placed in service for peroxide conveyance to insure peroxide stability. Passivate stainless steel piping systems by the following procedure:

- a. Washing interior of piping with detergent to remove all oil, grease, loose contaminants, etc.
- b. Rinse interior of piping with trichloroethylene.
- c. Rinse piping interior with clean, potable water, followed by draining to remove the contaminated washing medium.
- d. Contact piping interior with a 30 to 50 percent nitric acid solution.
- e. Thoroughly rinse piping interior with clean, potable water, and drain to remove all acid and water soluble contaminants. Contractor shall note that strong nitric acid solutions and hydrogen peroxide can react explosively. Precautions must be taken to insure nitric acid used in passivation is totally removed from all equipment prior to the introduction of hydrogen peroxide.

3.12 FIELD QUALITY CONTROL

3.12.1 Hydrostatic Testing of Piping, Excluding Double-Walled HDPE Piping

Before final acceptance of the work, the Contractor shall conduct pressure and leakage testing on all newly installed pipelines, and furnish all necessary equipment and material and make all connections to the pipe as required. The NTR shall monitor the tests. The pressure test for water piping shall be a hydrostatic test at 100 psig for a period of one hour.

All process and water lines shall be tested. Air lines shall be pressurized with air to a pressure of 125 psig for a period of one hour.

3.12.2 Testing of Double-Walled HDPE Piping Systems

- a. For carrier pipe, apply a hydrostatic test pressure of 1.5 times the working pressure rating of the pipe. The system shall be brought up to pressure and allowed to equalize for 3 hours, then the pressure shall be monitored for a 3-hour test period. Since HDPE is a flexible material, pressure drop can occur for reasons other than a leak, such as temperature change. Acceptable makeup water tables per PPI TR 31/9-79 and ASME B31.8xN shall be provided by the piping system supplier.
- b. The annular space between the carrier and containment pipe shall be tested at 60 psi air pressure. Air pressure shall be allowed to equalize for 10 minutes, then monitor the pipe for the test period of 10 minutes, during which no drop in pressure shall be allowed. Prior to testing the annular space, the carrier pipe shall be pressurized with water to 60 psi.

3.13 FINISHES

Factory prepare, prime, and finish coat carbon steel pipe in accordance with manufacturer's recommendations for the intended service.

3.14 SUPPLEMENTS

The following pipe schedules contain a description of the pipes, joints, fittings, branch connections, flanges, unions, bolting, gaskets, solvent cement and thread lubricant for each pipe type. Refer to the drawings for the locations and sizes of each pipe type.

3.14.1 Carbon Steel Piping

Carbon steel piping shall be used for the riser on the water tower. Carbon steel piping shall also be used for the carbon service line to the activated carbon filters.

<u>Item</u>	<u>Size</u>	<u>Description</u>
Pipe		Black carbon steel, ASTM A106-94, Grade B seamless or ASTM A53 Rev A-93, Grade B seamless or ERW. Threaded, butt-welded, and flanged joints:
	1-1/2" & smaller	Schedule 80
	2" thru 10"	Schedule 40, except 4-inch and smaller in chlorine service; Schedule 80.
Joints	2" & smaller	Threaded or socket-welded; flanged at equipment as required or shown
	2-12" & larger	Butt-welded or flanged at valves and equipment.
Fittings	2" & smaller	Threaded or socket-weld, forged carbon steel, ASTM A105/A105M-94, 2,000- or

<u>Item</u>	<u>Size</u>	<u>Description</u>
		3,000-pound WOG (3,000-pound chlorine service), conforming to ANSI B16.11-91; bore to match pipe inside diameter.
	2-1/2" & larger	Wrought carbon steel butt-welding, ASTM A234/A234M-94, Grade WPB meeting the requirements of ANSI B16.9-93; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.
Branch Connections	2" & larger	Thredolet or socket in conformance with Fittings above.
	2-1/2" & larger	Butt-welding tee in accordance with Fittings above.
Flanges	2" & smaller	Forged carbon steel, ASTM A105/A105M-94, ANSI B16.5-88 Class 150 or Class 300 socket-weld or threaded, 1/16-inch raised face.
	2-1/2" & larger	Forged carbon steel, ASTM A105/A105M-94, ANSI B16.5-88 Class 150 or Class 300 slip-on or welding neck, 1/16-inch raised face; weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings.
Unions	2" & smaller	Threaded or socket-weld, forged carbon steel, ASTM A105/A105M-94, 2,000- or 3,000-pound WOG, integral ground steel-to-steel seats, AAR design meeting the requirements of ANSI B16.11-91, bore to match pipe.
Bolting	All	Carbon steel ASTM A193/A193M Rev A-94, Grade B7 studs and ASTM A194/A194M-94, Grade 2H hex head nuts. Quench and temper for chlorine service.
		When mating flange on equipment is cast iron and gasket is flat ring, provide ASTM A307-94, Grade B hex head bolts and ASTM A563-93, Grade A heavy hex nuts.
Gaskets	All flanges	General Service: 1/16-inch thick compressed nonasbestos composition flat ring type.
		Steam Service: Spiral wound, Type 304 stainless steel with nonasbestos filler, integral 1/8-inch thick carbon steel centering ring.
Thread Lubricant		Teflon tape.

<u>Item</u>	<u>Size</u>	<u>Description</u>
3.14.2 Stainless Steel Piping		

Stainless steel piping shall be used for the peroxide dosing system piping inside the building, on discharge piping in the extractions wells, and as where indicated on the drawings.

<u>Item</u>	<u>Size</u>	<u>Description</u>
Pipe	2" & smaller	Schedule 40S: ASTM A312/A312M-93, Type 304 seamless, pickled and passivated.
	2-1/2" thru 6"	Schedule 10S: ASTM A778 Rev A-90 "as-welded" grade, Type 304L.
Joints	2" & smaller	Threaded or flanged at equipment as required or shown.
	2-12" & larger	Butt-welded or flanged at valves and equipment.
Fittings	2" & smaller	Threaded Forged: 1,000 CWP, ASTM A182/A182M Rev C-93 Grade F304L.
	2-1/2" & larger	Butt-Welded: ASTM A774/A774M-94 Grade 304L conforming to MSS SP-43, "as-welded" grade, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.
Branch Connections	2" & larger	Tee or reducing tee in conformance with Fittings above.
	2-1/2" & larger	Butt-welding tee or reducing tee in accordance with Fittings above.
Flanges	All	Forged Stainless Steel: ASTM A182/A182M Rev C-93 Grade F304L, ANSI B16.5-88 Class 150 or Class 300, slip-on weld neck or raised face.
		Cast Carbon Steel: ASTM A216/A216M-93 Grade WCA, drilled, ANSI B16.5-88 Class 150 or Class 300 Van Stone Type with stainless steel stub ends, ASTM A240-94 Type 304L "as-welded grade", conforming to MSS-SP43, wall thickness same as pipe.
Unions	2" & smaller	Threaded Forged: ASTM A182/A182M Rev C-93 Grade F304 or F316, 2,000-pound or 3,000-pound WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11-91, bore to match pipe.
Bolting	All	Forged Flanges: Type 304 stainless steel, ASTM A320/A320M-94 Grade B8M hex head bolts and ASTM A194/A194M-94 Grade 8M hex head nuts.

<u>Item</u>	<u>Size</u>	<u>Description</u>
		Van Stone Flanges: Carbon steel ASTM A307-94 Grade B hex head bolts and ASTM A563-93 Grade A hex head nuts. Provide same on mating cast iron flange on valve or equipment with flat ring gasket.
Gaskets	All flanges	Process Water Service: 1/16 inch thick, compressed inorganic fiber with nitrile binder, rated to 700 degrees F and 1000 psi. Ring gaskets shall not be permitted. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange.
Thread Lubricant	2" & smaller	Teflon tape.

3.14.3 Polyvinyl Chloride Piping

Polyvinyl chloride (PVC) piping shall be used for process water inside the building and where indicated on the drawings.

<u>Item</u>	<u>Size</u>	<u>Description</u>
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784-92 and ASTM D1785-93. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule 80 PVC as Specified Under Pipe Above: ASTM D2466-94 and ASTM D2467-93 for socket-weld type and ASTM D2464-93 for threaded type.
Joints	All	Solvent socket-weld except where connection to valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1-89 drilling
Bolting	All	Flat Face Mating Flange or In Corrosive Areas: ASTM A193/A193M Rev A-94 Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M-94 Grade 8M hex head nuts. With Raised Face Mating Flange: Carbon steel ASTM A307-94 Grade B square head bolts and ASTM A563-93 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR)

<u>Item</u>	<u>Size</u>	<u>Description</u>
		rubber.
		Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564-93.
Thread Lubricant	All	Teflon Tape.

3.14.4 Copper Piping

Copper tubing/piping shall be used in the extraction well vaults, for instrument air in the building, and for condensate and refrigerant lines.

<u>Item</u>	<u>Description</u>
Pipe	Red brass, seamless, standard wall thickness, conforming to ASTM B43-94.
Tubing	Seamless, conforming to ASTM B88 Rev A-93 as follows: Condensate Service Type L, hard drawn Compressed air service Type L, hard drawn Refrigerant service Type L, hard drawn
Fittings	Commercially pure wrought copper, socket joint, conforming to ASTM B75-93, dimensions conforming to ANSI B16.22-89.
Flanges	Commercially pure wrought copper, socket joint, conforming to ASTM B75-93, faced and drilled 150-pound ANSI B16.24-91 standard.
Bolting	Other Services: ASTM A307-94, carbon steel, Grade A hex head bolts and ASTM A563-93 Grade A hex head nuts.
Gaskets	1/16-inch thick non-asbestos compression type, full face.
Solder	Other Services: 95-5 wire solder (95 percent tin, 5 percent antimony), conforming to ASTM B32-93 Grade 95TA. Do not use cored solder.

3.14.5 Double-Walled High Density Polyethylene Piping

Double-walled high density polyethylene (HDPE) piping shall be used for extracted groundwater between the extraction well vaults and the wastewater treatment building.

<u>Item</u>	<u>Size</u>	<u>Description</u>
General	All	Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and

<u>Item</u>	<u>Size</u>	<u>Description</u>
		supplied from the same raw material supplier.
Pipe		ASTM D3350-93, high density extra high molecular weight polyethylene, maximum allowable hoop stress 800 psi at 73.4 degrees F. Polyethylene resins shall conform to Type PE 3408 or better. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. Pipe wall thickness shall reflect the required SDR* and diameter, as shown in Table 8, ASTM F714-94. Design Stress Rating: ASTM F714-94, 800 psi hydrostatic.

Pressure Rating	SDR*
160	11

*SDR: standard dimension ratio =
OD/thickness

Centralizers

Carrier pipe shall be supported with full round centralizers welded to the carrier pipe. Centralizers shall be spaced in accordance with Plastic Piping Institute standards.

Centralizers shall be made from pipe grade resin 1/2-inch sheet stock HDPE.

Centralizers shall have openings at 6 o'clock and 12 o'clock. Openings shall be positioned to permit the free flow of liquid between the carrier pipe and containment pipe.

The minimum vertical opening shall be 0.75 inches or greater, allowing for internal beads.

The minimum horizontal opening shall be 1.25 inches at the 6 o'clock and 12 o'clock positions.

The outside diameter of the centralizer shall match the interior diameter of the containment pipe.

Centralizers shall be installed to

<u>Item</u>	<u>Size</u>	<u>Description</u>
		provide a continuous, drainable, dryable containment pipe to low points indicated on the Drawings.
Fittings		Molded fittings, butt fusion joined, conforming to ASTM D1248-84.
Flanges		ASTM A240-94 Type 304 stainless steel, 125-pound, ANSI B16.1-89 standard, Van Stone type with one-piece molded polyethylene stud ends, same rating as pipe.
Bolting		Carbon steel, ASTM A307-94 Grade B square head bolts and ASTM A563-93 Grade A heavy hex head nuts.
		Washers shall be same material as bolts.
Gaskets		Flat ring, 1/8-inch ethylene propylene rubber (EPR).

-- End of Section --

SECTION 15080

MECHANICAL INSULATION

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1994; Rev. A) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(1995; Rev. A) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessel
ASTM B 209	(1995) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM E 84	(1995) Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	(1990) Surface Burning Characteristics of Building Materials
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UNDERWRITERS LABORATORIES INC. (UL)

UL 723	(1993; R 1994) Surface Burning Characteristics of Building Materials
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1.2 QUALITY ASSURANCE

Provide new field-applied insulation for piping systems which are located within, on, under, and adjacent to buildings.

1.2.1 Air Distribution Systems

Obtain Contracting Officer's written approval of systems under Section 15950, "HVAC Testing/Adjusting/Balancing," before applying field insulation to air

distribution systems.

1.2.2 Piping Systems

Obtain Contracting Officer's written approval of HVAC water distribution systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field-applied insulation to HVAC water distribution systems. At Contractor's option and with Contracting Officer's written approval, piping systems may be insulated before systems are tested, adjusted, and balanced (TAB'd). Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device.

1.2.3 Surface Burning Characteristics

Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E 84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Accessory materials
- b. Adhesives, sealants, and coating compounds
- c. Piping insulation
- d. Piping insulation jackets

PART 2 PRODUCTS

2.1 PIPING INSULATION

Insulation material shall conform to Table 1. Insulation thickness shall be as listed in Table 2. Except for flexible cellular insulation, insulation thickness as specified in Table 2 shall be 1 inch greater for insulated piping systems located outside. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

2.1.1 Piping Insulation Jackets

2.1.1.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire retardant jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

2.1.1.2 Metal Jackets

- a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide

corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

- b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

PART 3 EXECUTION

3.1 PIPE INSULATION

3.1.1 Pipe Insulation (Except Cellular and Calcium Silicate Insulation)

Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center (o.c.) and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1 1/2 inches. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

- a. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating or manufacturer's weatherproof coating for outside service unless pipe is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages and thermometers, fill voids with vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 degrees F.

3.1.2 Flexible Cellular Insulation

Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheet-metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of acrylic latex or equivalent finish as recommended by insulation manufacturers to flexible unicellular insulation in outside locations. Do not use vinyl lacquer finish or equivalent. Use metal jackets on cellular insulation located outside.

3.1.3 Calcium Silicate Insulation

Provide in accordance with manufacturer's printed instructions.

3.1.4 Hangers and Anchors

Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields and protection saddles. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, minimum 8 pcf, molded glass fiber, minimum 8 pcf, or other approved material of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable. Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe. Where anchors are secured to chilled piping that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

3.1.5 Sleeves and Wall Chases

Where interior wall penetrates, extend a aluminum jacket 2 inches out on either side of wall and secure on each end with a band. Where floor penetrates, extend a metal jacket from a point below back-up material to a point 10 inches above floor with one band at the floor and one not more than one inch from end of metal jacket. Where exterior wall is penetrated, extend metal jacket through sleeve to a point 2 inches beyond interior surface of wall.

3.1.6 Flanges, Unions, Valves and Fittings for Piping

Provide insulation for cold piping and hot piping of 110 degrees F or higher. Factory fabricated removable and reusable insulation covers may be used. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2 1/2 inches, elbows insulated using segments shall not have less than three segments per elbow. Place and joint segments with manufacturer's recommended water-vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. Total dry film thickness shall not be less than 1/16 inch.

Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. Provide finish coating as follows:

- a. PVC Fitting Covers: Factory premolded one-piece PVC fitting covers may be provided in lieu of two coats of adhesive with tape embedded between coats. Provide factory premolded field-fabricated segment or blanket insert insulation under fitting covers. Install factory premolded one-piece PVC fitting covers over insulation. Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather. Provide PVC fitting covers only in ambient temperatures below 150 degrees F.

3.1.7 Piping Exposed to Weather

3.1.7.1 Metal Jackets

Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch centers. Overlap longitudinal joints down to shed water. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

3.1.7.2 Flanges, Unions, Valves, Fittings, and Accessories

Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches.

3.2 FIELD QUALITY CONTROL

Visually inspect to ensure that materials provided conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE 1

Insulation Material For Piping

Service	Material	Spec.	Type	Class	Vapor Barrier Required
Refrigerant Suction Piping (35oF nominal), 4" PVC process service line from the influent floor penetration to the influent nozzle on the UV/chemical oxidation system.	Flexible Cellular Cellular Glass	ASTM C 534 ASTM C 552	I	1	No Yes
Condensate Return (201 to 250oF)					
Drinking Fountain, Drain Piping (to sewer tie in)	Flexible Cellular	ASTM C 534	I		No
Exposed Lavatory Drains, Exposed Domestic Water	Flexible Cellular	ASTM C 534	I		No

TABLE 1

Insulation Material For Piping

Service	Material	Spec.	Type	Class	Vapor Barrier Required
Piping & Drains to Areas for Handicap Personnel					
A/C condensate Drain Located Inside Bldg.	Flexible Cellular	ASTM C 534	I		No
Calcium Silicate Steam (251 to 350oF)	ASTM C 533	I		No	

TABLE 2

Piping Insulation Thickness (inch)

Service	Material	Tube And Pipe Size (Inches)				
		1/4-1 1/4	1 1/2-3	3 1/2-5	6-10	11-36
Refrigerant Suction Piping (35oF nominal)	Flexible cellular	0.5	1	1	1	1
Calcium Silicate Condensate Return (201o to 250oF)	1.5 Cellular Glass	1.5 2*	2.5 3*	2.5 4*	2.5 4*	4.5*
Exposed Lavatory	Flexible	0.5	0.5	0.5	0.5	0.5

TABLE 2

Piping Insulation Thickness (inch)

Service	Material	Tube And Pipe Size (Inches)				
		1/4-1 1/4	1 1/2-3	3 1/2-5	6-10	11-36
Drains, Exposed Domestic Water Piping & Drains to Areas for Handicap Personnel	cellular					
A/C condensate Drain Located Inside Bldg.	Flexible cellular	0.5	0.5	0.5	0.5	0.5
Steam (251o to 350oF)	Calcium Silicate	2	2.5	3	3	3
		2.5*	3.5*	4.5*	4.5*	5*

-- End of Section --

SECTION 15081

EXTERIOR PIPING INSULATION
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209 (1995) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C 533 (1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation

1.2 SYSTEM DESCRIPTION

Provide field-applied insulation for exterior steam piping, existing insulated piping affected by Contractor's operation, and exterior condensate piping.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-06, Instructions

- a. Installation manual for field-applied insulation

PART 2 PRODUCTS

2.1 PIPING INSULATION

Products containing asbestos will not be permitted.

2.1.1 Calcium Silicate Pipe Insulation

ASTM C 533.

2.2 MINIMUM THICKNESS OF INSULATION FOR STEAM PIPING

2.2.1 Calcium Silicate Pipe Insulation

Nominal Pipe Sizes (Inches)	Piping in Tunnels Piping in Manholes Insulation Thickness (Inches)	Piping Under Piers (Not in Trenches) Insulation Thickness (Inches)
<hr/>	<hr/>	<hr/>

less than 3

4.0

5.0

2.3 ALUMINUM JACKET

ASTM B 209, Temper H14, minimum thickness of 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.

PART 3 EXECUTION

3.1 INSTALLATION

Obtain Contracting Officer's written approval of piping systems prior to the application of insulation. Insulation shall be clean, dry, and installed prior to the application of insulation jacket. Do not use short pieces of insulation and jacket materials where a full length section will fit. Provide insulation materials and jackets with smooth and even surfaces, with jackets drawn tight, and secured on longitudinal and end laps. Insulate fittings and piping accessories with premolded, precut, or field-fabricated pipe insulation of the same pipe insulation material and thickness as the adjoining pipe insulation. Provide unions, flanges, valves, and piping accessories with removable (snap-on) sections of insulation. Provide insulation continuous through pipe hangers and pipe supports. Do not step on or walk on insulation or jacket.

3.2 PIPING INSULATION

3.2.1 Calcium Silicate Pipe Insulation

Install in accordance with the manufacturer's recommendations, except as modified herein. Secure with not less than 0.375 inch width fibrous glass reinforced waterproof tape or stainless steel bands spaced not more than 8 inches on centers. Provide one layer of asphalt-saturated felt over the insulation prior to installing aluminum jacket. Factory-applied polyethylene and kraft paper moisture barrier will not be permitted as a substitute for the asphalt-saturated felt.

3.3 INSULATION JACKET

Provide new piping insulation affected by Contractor's operations with aluminum jacket. Machine cut the jacket to produce a straight, smooth edge. Lap longitudinal and circumferential seams not less than 2 inches. Install jackets on horizontal piping with the longitudinal seam approximately midway between horizontal centerline and the bottom side of pipe. Install with the top edge of jacket overlapping the bottom edge of jacket and with the seam of each jacket offset from the seam of the adjacent jacket. Install jackets on vertical piping and on piping pitched from the horizontal from low point to high point so that the lower circumferential edge of each jacket overlaps the jacket below it. Provide factory prefabricated covers for insulation on fittings, valves, and flanges. Finish jackets neatly at pipe hangers and pipe supports. Terminate jackets neatly at the ends of unions, valves, traps, and strainers. Secure jacket with stainless steel bands spaced not more than 8 inches on center.

3.3.1 Additional Requirements for Insulated Piping Under Piers

Provide one layer of asphalt-saturated felt over the insulation prior to installing stainless steel jacket.

3.3.2 Under Pier Stainless Steel Jacket

In addition to the above requirements for aluminum jackets, secure longitudinal and circumferential seams with stainless steel screws spaced not more than 4 inches on centers. At approximately every 20 linear feet of piping, lap the circumferential seams not less than 6 inches; omit the screws.

-- End of Section --

SECTION 15100

VALVES AND OPERATORS

03/97

PART 1 GENERAL

1.1 REFERENCES

The following is a list of standards which may be referenced in this section:

American Society for Testing and Materials (ASTM)

ASTM A 276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 351	Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts
ASTM B 61	Standard Specification for Steam or Valve Bronze Castings
ASTM B 62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 98	Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B 127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
ASTM B 139	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes
ASTM B 164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B 194	Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B 584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM D 429	Test Methods for Rubber Property-Adhesion to Rigid Substrates
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

American Water Works Association (AWWA)

AWWA C 504	Standard for Rubber-Seated Butterfly Valves
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PART 2 PRODUCTS

2.1 GENERAL

- a. Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.
- b. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- c. Valve same size as adjoining pipe.
- d. Valve ends to suit adjacent piping.
- e. Size operator to operate valve for the full range of pressures and velocities.
- f. Valve to open by turning counterclockwise.
- g. Factory mount operator, actuator, and accessories.

2.2 MATERIALS

- a. Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
- b. Approved alloys are of the following ASTM designations:
 1. ASTM B 61, ASTM B 62, ASTM B 98 (Alloy UNS No. C65100, C65500, or C66100), ASTM B 139 (Alloy UNS No. C51000), ASTM B 584 (Alloy UNS No. C90300 or C94700), ASTM B 164, ASTM B 194, and ASTM B 127.
 2. Stainless steel Alloy 18-8 may be substituted for bronze.

2.3 VALVES

2.3.1 Globe Valves

Type V200 Globe Valve 3 Inches and Smaller: All-bronze, union bonnet, inside screw, rising stem, TFE disc, rated 150-pound SWP, 300-pound WOG.

2.3.2 Ball Valves

- a. Type V300 Ball Valve 2 Inches and Smaller for General Water and Air Service: All-bronze, end entry type, RTFE seats, Teflon packing, hand lever operator, rated 150-pound SWP, 600-pound WOG, threaded end.
- b. Type V307 Stainless Steel Ball Valve 1/2 Inch to 2 Inches: ASTM A 276 GR 316 or ASTM A 351 GR CF8M stainless steel body, Type 316 stainless steel balls, three-piece type, screwed ends, rated 1,000-pound WOG, with seat, body seal, and stem packing reinforced PTFE, lever operator. Drill 1/16-inch hole on upstream side to vent the ball enclosure when in the closed position.

- c. Type V330 PVC Ball Valve 2 Inches and Smaller: Rated 150 psi at 73 degrees F, with ASTM D 1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals.

2.3.3 Plug Valves

- a. Type V400 Eccentric Valve 3 Inches and Smaller: Nonlubricated type rated 175 psig CWP, drip-tight shutoff with pressure from either direction, cast iron body, threaded ends, cast iron plug with round or rectangular port, coated with Buna-N or Hycar, seat Type 316 stainless steel or nickel, stem bearing self-lubricating stainless steel or reinforced Teflon, stem seal multiple V-rings, U-cups, or O-rings of nitrile rubber.

2.3.4 Butterfly Valves

- a. General: Butterfly valve specified as AWWA C 504 to be in compliance with AWWA C 504 and following requirements:
 - 1. Suitable for throttling operations and infrequent operation after periods of inactivity.
 - 2. Elastomer seats bonded or vulcanized to body shall have adhesive integrity of bond between seat and body assured by testing with minimum 75-pound pull in accordance with ASTM D 429, Method B.
 - 3. Bubble-tight with rated pressure applied from either side.
 - 4. No travel stops for the disc on interior of the body.
 - 5. Self-adjusting V-type or O-ring shaft seals.
 - 6. Isolate metal-to-metal thrust bearing surfaces from flowstream.
- b. Type V500 Butterfly Valve:
 - 1. Flanged end, short body type.
 - 2. AWWA C 504, Class 150B.
 - 3. Set screws to lock set retainer in position.
- c. Type V501 Butterfly Valve:
 - 1. Flanged end, short body type.
 - 2. 304 stainless steel wetted parts.
 - 3. Set screws to lock set retainer in position.

2.3.5 Check Valve

- a. Type V600 Check Valve 2 Inches and Smaller: All-bronze, screwed ends and cap, swing type replaceable Buna-N disc, rated 125-pound SWP, 200-pound WOG.
- b. Type V604 Check Valve 2-1/2 Inches Through 12 Inches: Flanged end,

cast iron body, bronze mounted swing type, solid bronze hinges, stainless steel hinge shaft, rated 125-pound SWG, 200-pound WOG.

- c. Type V606 Check Valve 2-1/2 Inches Through 12 Inches: Flanged end, cast iron body, bronze mounted swing type, solid bronze hinges, stainless steel hinge shaft, outside lever and weight, rated 125-pound SWP, 200-pound WOG.
- d. Type V633 Stainless Steel Ball Check Valve 2 Inches and Smaller:
 - 1. Body, Cover, Poppet: Type 304 stainless steel.
 - 2. Cover Gland: Stainless steel.
 - 3. Ball, Spring: 300 Series stainless steel.

2.3.6 Self-Contained Automatic Valves

- a. Type V710 Pressure-Reducing Valve 2-1/2 Inches and Smaller:
 - 1. Direct diaphragm operated, spring controlled, bronze body.
 - 2. Size(s) and rating(s) as follows:
 - a) 2-inch, maximum of 80 gpm, with inlet pressure of 125 psig. Outlet pressure set at 70 psig.
- b. Type V730 Pressure-Relief Valve 2 Inches and Smaller:
 - 1. Direct diaphragm, spring controlled, cast iron body, spring case, nitrile seat neoprene diaphragm, stainless steel valve stem.
 - 2. To open when upstream pressure reaches a maximum set point.
- c. Type V744 Air Release Valve:
 - 1. Suitable for water service, automatically exhaust small amounts of entrained air that accumulates in a system, in CLOSED position, seat against resilient seat to prevent water leakage.
 - 2. Rated 150 psi working pressure, cast iron, ductile iron, or semi-steel body, cover with stainless steel float and trim.

2.3.7 Miscellaneous Valves

- a. Type V940 Solenoid Valve 2 Inches and Smaller:
 - 1. Two-way internal pilot operated diaphragm type, brass body, resilient seat suitable for air or water, solenoid coil molded epoxy, NEMA Class A, 120 volts ac, 60-Hz, unless otherwise indicated. Solenoid enclosure NEMA 250, Type 4 unless otherwise indicated. Size and normal position (CLOSED when de-energized) as indicated.
 - 2. Minimum operating pressure differential no greater than 5 psig, maximum operating pressure differential not less than 125 psig.

2.4 OPERATORS

2.4.1 Manual Operator

a. General:

1. Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.
2. Operator self-locking type or equipped with self-locking device.
3. Position indicator on quarter-turn valves.
4. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.

b. Exposed Operator:

1. Galvanized and painted handwheels.
2. Lever operators allowed on quarter-turn valves 8 inches and smaller.
3. Cranks on gear type operators.
4. Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
5. Valve handles to take a padlock, and wheels a chain and padlock.

c. Buried Operator:

1. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
2. Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.
3. Buried valves shall have extension stems, bonnets, and valve boxes.

PART 3 EXECUTION

3.1 INSTALLATION

a. Flange Ends

1. Flanged valve boltholes shall straddle vertical centerline of pipe.

2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.
- b. Screwed Ends
 1. Clean threads by wire brushing or swabbing.
 2. Apply joint compound.
- c. Valve Orientation
 1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
 2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.
 3. Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.
 4. If no plug valve seat position is shown, locate as follows:
 - a) Horizontal Flow: The flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve.
 - b) Vertical Flow: Install seat in the highest portion of the valve.
- d. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
- e. Install safety isolation valves on compressed air.
- f. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

3.2 TESTS AND INSPECTION

- a. Valve may be either tested while testing pipelines, or as a separate step.
- b. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.
- c. Inspect air valves as pipe is being filled to verify venting and seating is fully functional.
- d. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.
- e. Set, verify, and record set pressures for all relief and regulating valves.

- f. Automatic valves to be tested in conjunction with control system testing.

-- End of Section --

SECTION 15183

STEAM SYSTEM AND TERMINAL UNITS

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|--------------|---|
| ANSI A13.1 | (1981; R 1993) Scheme for the Identification of Piping Systems |
| ANSI B16.18 | (1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings |
| ANSI B16.24 | (1991; Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500 |
| ANSI B18.2.1 | (1981; R 1992) Square and Hex Bolts and Screws Inch Series |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- | | |
|-------------------|--|
| ASME B1.1 | (1989) Unified Inch Screw Threads (UN and UNR Thread Form) |
| ANSI/ASME B1.20.1 | (1983; R 1992) Pipe Threads, General Purpose (Inch) |
| ANSI/ASME B16.3 | (1992) Malleable Iron Threaded Fittings |
| ASME/ANSI B16.5 | (1988; Errata 1988) Pipe Flanges and Flanged Fittings |
| ASME/ANSI B16.9 | (1993) Factory-Made Wrought Steel Buttwelding Fittings |
| ASME B16.11 | (1991) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.20 | (1993; Errata 1994) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral-Wound, and Jacketed |
| ASME B16.21 | (1992) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME/ANSI B16.22 | (1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME/ANSI B16.34 | (1988) Valves - Flanged, Threaded, and |

Welding End

ASME/ANSI B16.39	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME B31.1	(1995) Power Piping
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC	(1995) Boiler and Pressure Vessel Codes
ASME BPVC SEC VIII D1	(1995) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1
ASME BPVC SEC IX	(1995) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1995) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1994; Rev. A) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 194/A 194M	(1995) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM B 32	(1995; Rev. A) Solder Metal
ASTM B 88	(1995) Seamless Copper Water Tube

AMERICAN WELDING SOCIETY, INC. (AWS)

ANSI/AWS Z49.1	(1994) Safety in Welding and Cutting
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COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA 404/0	Copper Tube Handbook
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50494	Exhaust Head, Steam
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FEDERAL SPECIFICATIONS (FS)

FS PPP-T-66	(Rev. E Reinst) Tape, Packaging, Vinyl
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Plastic Film

FS WW-U-516

(Rev. B) Unions, Brass or Bronze, Threaded
Pipe Connections and Solder-Joint Tube
Connections

FS QQ-B-654

(Rev. A) Brazing Alloys, Silver

FS WW-T-696

(Rev. E) Traps, Steam and Air

FS WW-S-2739

Strainers, Sediment: Pipeline, Water,
Air, Gas, Oil, or Steam

FS S-U-2833

Unit Heater, Air-Circulating, Steam - Hot
Water

MILITARY SPECIFICATIONS (MIL)

MIL-V-16733

(Rev. D) Valves, Pressure Regulating, Steam

MIL-E-17813

(Rev. F) Expansion Joints, Pipe, Metallic
Bellows

MIL-V-18499

(Rev. E) Valves, Air Venting, Steam

MIL-V-18634

(Rev. B) Valves: Safety, Relief, and
Safety-ReliefMANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY, INC. (MSS)

MSS SP-45

(1992) Bypass and Drain Connection Standard

MSS SP-58

(1993) Pipe Hangers and Supports -
Materials, Design and Manufacture

MSS SP-69

(1991) Pipe Hangers and Supports -
Selection and Application

MSS SP-80

(1987) Bronze Gate, Globe, Angle and Check
Valves

1.2 GENERAL REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section, with the additions and modifications specified herein. This section includes steam and condensate piping, unit heaters, used for heating within the building. Steam boilers, feedwater treatment equipment, process steam terminal units, boiler feed piping, and blow-off piping are not covered in this section.

1.2.1 Classes and Maximum Working Pressures

Equipment, piping, and piping components shall be suitable for use under the maximum working pressure indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications.

1.2.2 Standard Commercial Product

The terminal units provided shall, as a minimum, comply with the features specified herein and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited herein but which are a part of the manufacturer's standard commercial product, shall be included in the terminal units being furnished. A standard commercial product is a product which has been sold or is currently being offered for sale, on the commercial market through advertisements or manufacturer's catalogs or brochures. Provide Institute of Boiler and Radiator Manufacturer (IBR) or Steel Boiler Institute (SBI) rating for required capacity.

1.2.3 Welding Safety

ANSI/AWS Z49.1.

1.2.4 Definitions

1.2.4.1 High Pressure Piping System

A system whose pressure is greater than 15 psig and shall conform to ASME B31.1.

1.2.4.2 Low Pressure Piping System

A system whose pressure is 15 psig or less.

1.2.4.3 Terminal Unit

An enclosed unit that provides heated air from a steam coil and includes natural convection units, radiation, and forced air units.

1.2.4.4 Piping and Piping System

Includes pipe, tubing, flanges, bolting, gaskets, valves, safety valves, fittings, and pressure containing parts of other piping components, hangers, supports, guides, expansion joints, anchors, and other equipment items necessary to prevent overstressing the pressure containing parts.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Unit heaters
- b. Valves
- c. Valve operating mechanism
- d. Steam meters
- e. Traps
- f. Strainers
- g. Expansion joints

h. Pipe anchors

i. Pipe guides

j. Instrumentation

1.3.2 SD-06, Instructions

a. Unit heaters

Include manufacturer's recommendations for equipment foundations.

1.3.3 SD-08, Statements

a. Welding procedure

b. Welder's Performance Qualification Record

c. List of welders and welder's symbols

1.3.3.1 Welding Procedure

Submit welding procedure specification for metals included in the work, together with proof of the procedure's qualifications as outlined in ASME B31.1.

1.3.3.2 Welder's Performance Qualification Record

Submit to the Contracting Officer the Welder's Performance Qualification Record in conformance with ASME B31.1 for each welder, showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, the Contractor shall submit list of welders and welder's symbols, assigned number, or letter which shall be used to identify the work of the welder which shall be affixed immediately upon completion of the weld. Welders making defective welds after passing a qualification test shall be required to take a requalification test. Welders failing the requalification tests will not be permitted to work under this contract.

1.3.3.3 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to approval if the conditions specified in ASME B31.1 are met before a procedure can be used.

1.3.4 SD-10, Test Reports

a. Steam piping tests

b. Copper tubing test

c. Valves tests

d. Expansion joints tests

e. Instrumentation tests

- f. Pipe and pipe system
- g. Unit heaters tests

Submit reports of tests required by the reference specification and standards.

PART 2 PRODUCTS

2.1 PIPE AND PIPE SYSTEM

2.1.1 High Pressure Steam Piping System (Over 15 psig)

ASME B31.1 for a steam working pressure of 100 psig and a temperature of 350 degrees F.

2.1.1.1 High Pressure Steam Piping

ASTM A 106 or ASTM A 53, Grade B, Schedule 40, black steel, seamless. Use ASTM A 53 pipe for bending.

2.1.2 Low Pressure Steam Piping System

ASME B31.1 for a steam working pressure of 15 psig or less, a condensate pressure of 15 psig, and a temperature of 250 degrees F.

2.1.2.1 Low Pressure Steam Piping

- a. Steel Piping: ASTM A 53, Schedule 40, black, seamless. Use ASTM A 53 pipe for bending.
- b. Copper Tubing: ASTM B 88, Type K.

2.1.3 Condensate Return Piping (100 psig or Less)

2.1.3.1 Steel Piping

ASTM A 106 or ASTM A 53, Grade B, Schedule 80, black, seamless.

2.1.4 Fittings

Provide fittings compatible in all respects (material, size, pressure, and temperature limitations) with the pipe being used and within any further limitations of ASME B31.1.

2.1.4.1 Fittings for Steel Pipe

- a. Sizes 1/8 to 2 inches:
 - (1) Steel Fittings: ASME B16.11, socket welding or threaded. Where pressure exceeds 15 psig, provide socket-welding type only.
 - (2) Malleable Iron Fittings: ANSI/ASME B16.3, threaded.
- b. Sizes 2 1/2 inches and larger:
 - (1) Steel Fittings: ASME/ANSI B16.9, butt welding or ASME/ANSI B16.5, flanged.

(2) Bronze Fittings: ANSI B16.24, flanged. Sizes larger than 8 inches are not permitted.

2.1.4.2 Fittings for Copper Tubing

ANSI B16.18, cast copper alloy or ASME/ANSI B16.22, wrought copper, solder joint type. Flared or compression joint type fittings for tube sizes not exceeding 2 inches outside diameter (O.D.) may be provided as permitted in ASME B31.1.

2.1.5 Unions

2.1.5.1 Unions for Steel Pipe

ASME/ANSI B16.39, threaded.

2.1.5.2 Unions for Copper Tubing

FS WW-U-516, solder joint end type.

2.1.6 Flanges

Remove the raised faces on flanges when used with flanges having a flat face.

2.1.6.1 Steel Flanges

ASME/ANSI B16.5, forged steel, welding type.

2.1.6.2 Bronze Flanges

ANSI B16.24, threaded.

2.1.7 Valves

Shall conform to the following paragraphs. End connections shall conform to paragraph entitled "End Connections."

2.1.7.1 Gate Valves

- a. Bronze Gate Valves: MSS SP-80, Type 1 (solid wedge, non-rising stem), 3 inches and smaller, threaded or solder joint ends, and not less than Class 150.

2.1.7.2 Globe and Angle Valves

- a. Bronze Globe and Angle Valves: MSS SP-80, Type 1 (metal disc, integral seat) or Type 3 (metal disc, renewable seat), 3 inches and smaller, threaded or solder joint ends, Class 200 except that Class 150 with solder joint ends may be used for copper tubing. Valves shall have renewable seats and discs, except solder joint end valves which shall have integral seats.
- b. Steel Globe and Angle Valves: ASME/ANSI B16.34, with trim suitable for the service temperature and pressure.

2.1.7.3 Check Valves

- a. Bronze Check Valves: MSS SP-80, Type 3 (swing check, metal disc

to metal seat), 3 inches and smaller, threaded or solder joint ends, Class 200, regrinding type.

2.1.7.4 Steam Pressure Reducing Valves

MIL-V-16733, Type I, Class 150, Construction carbon steel, cast iron prohibited.

2.1.7.5 Air Vent Valves

MIL-V-18499, with vacuum holding device, pressure rated for the intended service, and with capacity based on manufacturer's standard for the connection size, cast iron prohibited.

2.1.7.6 Safety Valves

MIL-V-18634, Type 1, Class 1, Style A, and sized in accordance with ASME BPVC. Set point shall be as indicated, cast iron prohibited.

2.1.8 End Connections

2.1.8.1 Steel Piping

Sizes 2 inches and smaller threaded or socket welded; sizes 2 1/2 inches and larger flanged or butt welded.

a. Threaded Joints: ANSI/ASME B1.20.1.

b. Flanged Joints: Flanges shall conform to paragraph entitled "Flanges." Bolting and gaskets shall be as follows:

(1) Bolting: Material used for bolts and studs shall conform to ASTM A 307, Grade B; and material for nuts shall conform to ASTM A 194/A 194M, Grade 2. Dimensions of bolts, studs, and nuts shall conform to ANSI B18.2.1 and ASME/ANSI B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt-studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semifinished hexagonal nuts, conforming to ANSI B18.2.1 and ASME/ANSI B18.2.2.

(2) Gaskets: Gaskets shall be as follows:

Working Conditions

Material

Saturation

15 psig 250 degrees F

Composition or Copper

Superheated Steam

Less Than 750 degrees F

100 psig 330 degrees F

Metal-Jacketed Composition,
Monel, Steel, or Soft Steel

Gaskets shall be as thin as the finish of surfaces will permit. Metal or metal-jacketed non-asbestos gaskets shall be used with small male and female or small tongue-and-groove flanges or flanged fittings; they may be used with steel flanges with lapped, large male and female, large tongue-and-groove, or raised faces.

Full faced gaskets shall be used with flat-faced bronze flanges. Lapped steel flanges, or raised-face steel flanges shall have ring gaskets with an outside diameter extending to the inside of the bolt holes. Widths of gaskets for small male and female and for tongue-and-groove joints shall be equal to the widths of the male face or tongue. Gaskets shall have an inside diameter equal to or larger than the port openings. Rings for ring joints shall be in accordance with dimensions in ASME B16.20, suitable for the service conditions encountered, and shall be softer than the flanges. Dimensions for non-metallic gaskets shall be in accordance with ASME B16.21.

- c. Butt Weld Joints: ASME B31.1. The use of backing rings shall conform to ASME B31.1. Ferrous rings shall be of good weldable quality and shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Backing rings shall be continuous machined or split band type.

- d. Socket Weld Joints: ASME B31.1.

2.1.8.2 Joints for Copper Tubing

- a. Solder Joints: ASTM B 32, alloy grade Sb5 solder for steam pressure 15 psig or less.
- b. Brazed Joints: FS QQ-B-654 for steam pressure 120 psig or less.

2.1.9 Expansion Joints

2.1.9.1 Packless Type

MIL-E-17813, Type II, Class 2, located as indicated. Bellows material shall be seamless corrosion resistant steel.

2.1.10 Instrumentation

2.1.10.1 Pressure and Vacuum Gages

ANSI/ASME B40.1 with restrictor, locate as indicated.

2.1.10.2 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers (mercury is not acceptable) shall have a nominal scale diameter of 5 inches. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem, and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 3 1/2 inches. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

2.1.11 Miscellaneous Pipeline Components

2.1.11.1 Steam Meters

- a. Rotary Axial-Turbine Steam Meter

1. Provide rotary axial-turbine totalizing type designed for mounting directly in the steam line (for sizes up to 4 inches inclusively) or in a bypass piping arrangement with orifice plate in the main line (for sizes 5 inches and up). Bypass meter shall be furnished for horizontal or vertical upward flow or vertical downward flow.
2. The meter shall be self-contained and self-operating requiring no mercury, pressure piping, compressed air, or electrical connections except for operation of accessory contacts where required or desired. The meter shall include a dampened fan shaft assembly, fixed internal orifice, and magnetically driven counter of dial and pointer type. Stuffing box shall not be allowed.
3. Materials of construction shall be cast iron body with 250 pounds flanged ends for pressures up to 250 psig and temperatures up to 450 degrees F. Wear parts shall be of monel or stainless steel with graphite top bearing and jewelled bottom bearing.
4. Meter shall be direct reading in pounds of steam over a 10 to 1 range, with continuous overload capability up to 150 percent of rated capacity and temporary overload capability up to 200 percent of rated capacity.
5. Accuracy shall be within plus or minus 2 percent of actual flow over the entire 10 to 1 range at flow rates and pressures within the limits set forth in the capacity tables.

2.1.11.2 Air Traps

FS WW-T-696 for float-operated steam traps (non-thermostatic), except that the valve mechanism shall be inverted so as to be closed, not opened, by rising water. Arrange float-controlled valves to close promptly when water enters the traps. Locate traps as indicated.

2.1.11.3 Steam Traps

FS WW-T-696, Type VI, thermostatic and non-thermostatic steam traps. Provide traps with separate strainers and locate as indicated. Type V, Style A thermodynamic traps.

2.1.11.4 Strainers

FS WW-S-2739, Style Y (Y pattern) for Class 125 and 250 piping in sizes 1/2 to 8 inches, inclusive, locate as indicated, cast iron prohibited.

2.1.11.5 Exhaust Heads

CID A-A-50494, for atmospheric discharge of exhaust steam.

2.1.11.6 Pipe Guides

Laterally restrained insulated pipe supports shall be designed and manufactured for use with high pressure steam pipes. Working conditions of steam shall be less than 750 degrees F and 100 psig. Pipe support material, design, and manufacturing shall be in accordance with MSS SP-58 and ASME B31.1. Selection and application of pipe guides shall be in

accordance with MSS SP-69.

2.1.11.7 Pipe Anchors

Insulated positive pipe anchors shall be designed and manufactured for use as a positive stop anchor for axial, lateral, and vertical loads due to high pressure steam applications. Working conditions shall be less than 750 degrees F and 100 psig. Pipe anchor material, design, and manufacturing shall be in accordance with MSS SP-58 and ASME B31.1. Selection of pipe anchors shall be in accordance with MSS SP-69.

2.1.11.8 Other Pipe Hangers, Supports, Spacing Requirements, and Attachments

MSS SP-58 and ASME B31.1 for materials, design, and manufacture. MSS SP-69 for selection and application.

2.2 UNIT HEATERS

FS S-U-2833, propeller centrifugal fan type with both horizontal and vertical air delivery and with capacity as indicated for the design conditions. Fans shall be dynamically balanced only. Each unit heater shall be controlled by a manufacturer-furnished line voltage thermostat (16 amperes at 115 volts with a temperature range from 45 degrees F to 85 degrees F). Provide thermostat with clear plastic guard.

PART 3 EXECUTION

3.1 INSTALLATION

Work material and equipment into a complete, convenient, and economical system or systems; and provide apparatus, parts, materials, and accessories which are necessary to accomplish this result.

3.1.1 Piping

Fabricate, assemble, weld, solder, braze, and install piping and pipe system in accordance with ASME B31.1 and as further qualified herein. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established, for the work shown, by the Contractor, and work into place without springing or forcing, except where cold-springing is indicated. Locate piping and equipment within buildings entirely out of the way of lighting fixtures, conduit, and doors, windows, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit the welding of joints; at least 6 inches for pipe sizes 4 inches and smaller, 10 inches for pipe sizes larger than 4 inches, and in corners provide sufficient clearance to permit the welder to work between the pipe and one wall. Make provision for expansion and contraction of pipe lines. Do not bury, conceal, or insulate piping until it has been inspected, tested, and approved. Do not conceal piping in walls, partitions, underground, or under the floor except as indicated. Where pipe passes through building structure, do not conceal pipe joints, but locate where they may be readily inspected and not weaken building structure. Run insulated pipe as shown and as required with sufficient clearance to permit application of insulation. Use flanged joints only where necessary for normal maintenance and where required to match valves and equipment. Gaskets, packing, and thread compounds shall be suitable for the service. Apply joint compound or tape on male thread only. Use long radius ells wherever possible to reduce pressure drops. Pipe bends may be used in lieu

of welding fittings where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Run piping as indicated, and avoid interference with other piping, conduit, or equipment. Run vertical piping plumb and straight and parallel to walls, except where specifically shown otherwise. Do not trap lines, except where indicated. Use reducing fittings for changes in pipe sizes. The use of bushings is prohibited. In horizontal lines 2 1/2 inches and larger, use reducing fittings of the eccentric type to maintain the bottom of the lines in the same plane for steam lines and to maintain the top of the lines in the same plane for condensate lines except where a trap or pocket would result. Provide suitable size sleeves for lines passing through building structure. Install piping connected to equipment to provide flexibility for thermal stresses and for vibration. Support and anchor pipe so that strain from weight and thermal movement of piping is not imposed on the equipment. Thoroughly clean each section of pipe, fittings, and valves of foreign matter before erection. Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter; pipe 2 inches and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to the apparatus, thoroughly wash out the piping interior with water. Blow out steam piping with high-pressure steam, if available, or compressed air, removing rust, oil, chips, sand, and other material. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where any foreign matter might accidentally enter pipe.

3.1.1.1 Welding

- a. Welding of Piping: Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and preparation and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards indicated in Chapter VI of ASME B31.1.
- b. Quality of Welds: Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.
- c. Arc Welding and Gas Welding: In accordance with ASME BPVC SEC IX.

3.1.1.2 Brazing and Soldering

- a. Brazing and soldering procedure qualification shall conform to ASME B31.1. Brazing procedure for joints shall be as outlined in the CDA 404/0.
- b. Soldering, soldering preparation, and procedures for joints shall be in accordance with ASME B31.1 and as outlined in the CDA 404/0.
- c. Copper Tube Extracted Joint: An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form

a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

3.1.1.3 Pipe Guides, Anchors, Hangers and Supports

Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Continuous inserts and expansion bolts may be used.

3.1.1.4 Grading and Venting of Pipe Lines

Unless otherwise indicated, install horizontal lines of steam and return piping to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction. When counterflow of condensate within the steam pipe occurs in a portion of a pipeline, pitch up in the direction of steam flow a minimum of 6 inches per 100 feet and increase pipe diameters by one standard pipe size. Steam mains pitched away from the boiler shall contain drip connection and air vent valves at the extreme end. Air vents shall be provided at the highest point of any vertical riser. Drip connections shall not be interconnected above the water line of the boiler.

3.1.1.5 Pipe Sleeves

Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Use Schedule 40 galvanized steel pipe sleeves in outside walls below and above grade, in floor, and in roof slabs. Sleeves in partitions shall be zinc-coated sheet steel having a weight of not less than 0.907 psf. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Pack space between the pipe or tubing and the sleeve firmly with oakum and caulk both ends of the sleeve with elastic cement.

3.1.1.6 Floor, Wall, and Ceiling Plates

Secure plates to the pipe with enough clearance for thermal expansion of pipe. Use chromium-plated steel or nickel-plated cast iron plates on pipes passing through floors and partitions of toilet rooms and where indicated; use painted cast iron, malleable iron, or steel for all other plates.

3.1.1.7 Flashing for Buildings

Provide tight waterproof flashing where pipes pass through building roofs and outside walls.

3.1.1.8 Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each threaded end valve. Place unions or flanges as indicated. Use unions on piping

smaller than 2 inches in diameter, and use flanges on piping 2 inches and larger in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections. Dielectric fittings shall utilize a non-metallic filler which will prevent current flow. The spacer shall be suitable for the pressure and temperature of the service. The fittings shall otherwise conform to the requirements of paragraph entitled "Fittings."

3.1.1.9 Traps and Connections

Traps shall be of the type and capacity for the service and shall be properly supported and connected. Except for thermostatic traps in pipe coils, radiators, and convectors, install traps with a dirt pocket and strainer between it and the piping or apparatus it drains. When necessary to maintain in continuous service apparatus or piping which is to be drained, provide a three-valve bypass so that the trap may be removed and repaired and condensate may drain through the throttled bypass valve. Provide a check valve on the discharge side of the trap whenever the trap is installed for lift or operating against a back pressure, or discharges into a common return line. When a thermodynamic trap is used, a check valve is not required or recommended. Provide test connections on the discharge side of the high and medium pressure traps when they are specifically required. The test connection shall include a 1/2 inch globe valve with uncapped nipple.

3.1.1.10 Connections for Future Equipment

Locate capped or plugged outlets for connections to future equipment as indicated.

3.1.2 Valves

3.1.2.1 General

Install valves in conformance with ASME B31.1, ASME BPVC SEC VIII D1, and as required herein, at the locations indicated and elsewhere as required for the proper functioning of the system. Use gate valves unless otherwise directed. Install stop valves in the supply lines equipped or located so as to permit operation from floor level, or provided with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair. Provide gate valves 8 inches and larger with globe-valved bypass in accordance with MSS SP-45.

3.1.2.2 Globe Valves

Install globe valves so that the pressure shall be below the disk. Install globe valves with the stems horizontal on steam and exhaust lines.

3.1.2.3 Steam Pressure-Reducing Valves

Provide the steam line entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two cutout valves and with a globe or angle bypass valve and bypass piping. Provide each pressure-reducing valve unit with an indicating steam gage to show the reduced pressure, and a safety valve on the low pressure side with sufficient capacity to relieve the high pressure steam.

3.1.3 Pressure Gages

Install a shutoff valve or petcock between each pressure gage and the line, and gages on steam lines shall have a syphon installed ahead of the gage.

3.1.4 Thermometers

Provide thermometers and thermal sensing elements of control valves with a separable socket. Install separable sockets in pipe lines in such a manner to sense the temperature of the flowing fluid and minimize obstruction to flow.

3.1.5 Steam Meters

Provide steam meters with a suitable three-valve bypass to permit dismantling and inspection without interference with the service.

3.1.6 Strainers

Provide strainers with meshes suitable for the services where indicated, and where dirt might interfere with the proper operation of valve parts, orifices, and moving parts of equipment.

3.1.7 Equipment Foundations

Design equipment foundations of sufficient size and weight to provide isolation and to preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. When required by the Contracting Officer, the equipment manufacturer's approval of the foundation design and construction for the equipment involved shall be obtained.

3.1.8 Equipment Installation

Install equipment as specified and in accordance with the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in such a manner as not to place a strain on any of the equipment. Do not bolt flanged joints tight unless they match. Adequately extend expansion bends before installation. Grade, anchor, guide, and support piping without low pockets.

3.1.9 Cleaning of System

As installations of the various system components are completed, clean before final closing. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests shall not be performed until the cleaning is approved.

3.1.10 Cleaning and Painting of Piping and Equipment

Clean and paint piping and equipment in accordance with Section 09900, Paints and Coatings."

3.1.11 Identification of Piping

Labels for pipes 3/4 inch diameter and larger shall bear printed legends to identify contents of pipes and arrows to shown direction of flow. Labels shall have color coded background to signify levels of hazard in accordance with ANSI A13.1. Legends and type and size of characters shall also

conform as ANSI A13.1. Make labels of plastic sheet FS PPP-T-66 with pressure sensitivity suitable for the intended applications, or they may be premolded of plastic to fit over pipe. For pipe smaller than 3/4 inch diameter, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black filled characters.

3.2 FIELD TESTS AND INSPECTIONS

Field inspections, field tests, and trial operations specified in this section shall be performed by the Contractor. The Contractor shall provide gas, oil, labor, equipment, and incidentals required for testing, except that in accordance with Division 1 the Government will provide water or electric power required for tests. The Contractor shall give the Contracting Officer 14 days' advance written notice of the dates and times scheduled for tests and trial operations.

3.2.1 Field Inspections

Inspect piping system prior to initial operation, for conformance to drawings, specifications, and ASME B31.1. Equipment, material, or work rejected because of defects or non-conformance with drawings, specifications, and ASME B31.1 shall be replaced or corrected by the Contractor, as directed by the Contracting Officer.

3.2.2 Field Tests

Conduct the following tests after completion of the piping installation and prior to initial operation.

3.2.2.1 Piping System

Test piping system hydrostatically using water not exceeding 100 degrees F. Conduct tests in accordance with the requirements of ASME B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before any insulation covering has been applied. Test piping system at 1 1/2 times the system pressure or 50 psig whichever is greater. Before performing tests, remove or valve off from the system, gages, traps, and other apparatus which may be damaged by the test pressure. Install a calibrated test pressure gage in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of joints and connections. Perform tests after installation and prior to acceptance.

3.2.2.2 Start-Up and Operational Test

Start-up the system and initially operate with components operating. During the test, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of steam occur when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence.

3.2.2.3 Extent of Field Tests

After installation and before acceptance, subject the work of this section to necessary field tests, including those herein specified, and in Section 15950, "HVAC Testing/Adjusting/Balancing."

-- End of Section --

SECTION 15400

PLUMBING SYSTEMS

09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.36.2M	(1991) Cleanouts
ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.24	(1991; Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(1984) Drinking-Fountains, and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	(1988) Supports for the Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	(1994; Errata 1995) Plumbing Fixture Fittings
ASME A112.19.2M	(1995; Errata 1995) Vitreous China Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1995; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1994) Cast Iron Soil Pipe and Fittings
ASTM B 32	(1995; Rev. B) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1995; Rev. A) Seamless Copper Water Tube
ASTM C 564	(1995; Rev. A) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D 2665	(1995) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2846/D 2846M	(1995; Rev. A) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM F 441	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1990) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1990; Erratum 1991) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Threaded Flanges
ANSI/AWWA C151/A21.51	(1991) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993; Addendum 1995) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(1992) Disinfecting Water Mains

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
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FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC

List of Approved Backflow Prevention

Assemblies

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (1995; Supp. 1996) International Plumbing Code

MILITARY SPECIFICATIONS (MIL)

MIL-R-6855 (Rev. E; Supp. 1) Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH201 (1983) Water Hammer Arrestors

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide plumbing systems, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of the ICC IPC. Plumbing systems include piping less than 5 feet outside of building walls.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

- a. Pipe and fittings
- b. Valves
- c. Plumbing fixtures
- d. Water heaters
- e. Pipe hangers and supports
- f. Water hammer arresters
- g. Drains
- h. Backflow preventers

- i. Electric drinking fountains
- 1.4.2 SD-10, Test Reports
 - a. Backflow Preventers Test Report
- 1.4.3 SD-19, Operation and Maintenance Manuals
 - a. Water heaters, Data Package 2
 - c. Electric drinking fountains, Data Package 2

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Contracting Officer. Capacity of equipment shall be not less than that indicated.

PART 2 PRODUCTS

2.1 SANITARY DRAIN AND VENT PIPE AND FITTINGS

Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.

2.1.1 Buried Piping

Provide piping up to but not more than 6 inches aboveground or floor slab on grade.

2.1.1.1 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.1.2 Plastic Pipe, Fittings, and Solvent Cement

- a. Polyvinyl Chloride (PVC) System: ASTM D 2665.

2.1.2 Aboveground Piping

2.1.2.1 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2.2 Plastic Pipe, Fittings, and Solvent Cement

- a. Polyvinyl Chloride (PVC) System: ASTM D 2665.

2.1.3 Cleanouts

ANSI A112.36.2M; provide threaded bronze or thermoplastic or PVC plastic cleanout plugs.

2.1.3.1 Floor Cleanouts (FCO)

Provide cast-iron or ductile-iron floor cleanout with anchor flange, adjustable height polished bronze, nickel bronze, stainless steel, or chromium-plated copper alloy rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

2.1.3.2 Wall Cleanouts (WCO)

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.1.3.3 Cleanouts Exterior to Buildings (CO)

Provide cast-iron or polyvinyl chloride (PVC) cleanouts and countersunk plugs. Provide cast-iron cleanout box with cover.

2.1.4 Drains

ASME A112.21.1M; provide cast-iron or ductile-iron drains and clamping rings for use with membrane waterproofing. Provide P-traps for each floor drain.

2.1.4.1 Flush Strainer Floor Drains (FD-1)

Provide with double drainage flange, perforated or slotted cast bronze or nickel bronze, polished stainless steel, or chromium-plated copper alloy strainer, and adjustable collar. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.

2.1.4.2 Extended Rim Floor Drains (HD-1)

Provide as specified for flush strainer floor drains, except strainer body shall have one inch extended rim installed flush with finished floor.

2.2 DOMESTIC WATER PIPING

2.2.1 Buried Piping and Aboveground Piping

2.2.1.1 Copper Tubing

ASTM B 88, Type L or M for aboveground piping, Type K for buried piping, with ANSI B16.18 or ASME/ANSI B16.22 solder joint fittings; or with ASME/ANSI B16.26 flared joint fittings. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder. Provide copper tubing for pipe sizes 4 inches or smaller.

2.2.1.2 CPVC Plastic Pipe, Fittings, and Solvent Cement

ASTM D 2846/D 2846M, may be provided for sizes 2 inches and smaller. Provide transition union connections or threaded gate valve between copper

tubing and chlorinated polyvinyl chloride (CPVC) piping. Provide male threaded adapters with PTFE (polytetrafluoroethylene) pipe thread paste for threaded connections to valves, strainers, and equipment.

2.2.1.3 Cast Ductile-Iron Piping

Sizes larger than 4 inches, outside coated, AWWA C104/A21.4 cement mortar lined, ANSI/AWWA C151/A21.51 ductile-iron pipe, AWWA C111/A21.11 rubber gasket joints, and AWWA C110/A21.10 fittings. Provide concrete thrust blocks at the elbow where the buried piping turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Aboveground piping shall have flanged end connections conforming to AWWA C115/A21.15 for flanged pipe and AWWA C110/A21.10 for flanged fittings.

2.2.2 Water Valves

2.2.2.1 Hose Bibbs (HB-1)

Provide angle type copper alloy hose bibb with lockshield and handwheel or tee-handle. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

2.2.3 Dielectric Connections

Provide at connections between copper and ferrous metal piping materials. ASTM F 441, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.

2.2.4 Water Hammer Arresters

PDI WH201.

2.2.5 Backflow Preventers (BFP)

Reduced pressure principle type with a maximum pressure drop of 10 psi. Furnish proof that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the FCCCHR-USC or local code. Listing of the particular make, model/design, and size in the current FCCCHR-USC or local code will be acceptable as the required proof.

2.3 MISCELLANEOUS PIPING MATERIALS

2.3.1 Flanges

ASME/ANSI B16.1, Class 125, for use in ferrous piping; ASME/ANSI B16.22 or ANSI B16.24 for use in copper tubing; with MIL-R-6855 full face flat type synthetic rubber gaskets.

2.3.2 Pipe Sleeves

2.3.2.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel, ductile-iron or cast-iron pipe sleeves.

2.3.2.2 Sleeves in Non-Masonry or -Concrete Walls, Floors, and Roofs

Provide 26 gage hot-dip galvanized steel sheet.

2.3.3 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

- a. Sleeves in masonry and concrete walls, floors, and roofs: Provide steel pipe sleeves. Sleeves are not required where sanitary drain and vent piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.
- b. Sleeves in other than masonry and concrete walls, floors, and roofs: Provide 26 gage galvanized steel sheet.

2.3.4 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.4 PLUMBING FIXTURES

Provide the following types of plumbing fixtures as indicated. Provide plumbing fixture faucets, fittings, trim, accessories, and supplies as specified in paragraph entitled "Plumbing Fixture Faucets, Trim, and Fittings."

2.4.1 Flush Valve Plumbing Fixtures

- a. Flush Valves: Provide large (not less than 2.625 inches in diameter minimum upper chamber inside diameter where the diaphragm is sealed between the upper and lower chambers) diaphragm flush valves for domestic water service. Provide vacuum breakers and angle control-stop valves for each flush valve. Exposed to view and pressure containing components of flush valves, vacuum breaker, angle control-stop valve, tail pieces, slip nuts, escutcheon plates, and wall plates shall be chromium-plated copper alloy or polished stainless steel. Mount flush valves not less than 11 inches above the fixture. Water flushing volume of the flush valve shall be factory set as required by the fixture.

- b. Flush Valve Water Closets (WC-1): Designed for use by individuals with physical disabilities. ASME A112.19.2M, white vitreous china, siphon jet, elongated bowl, floor-mounted, floor or wall outlet as indicated. Water flushing volume of the flush valve and water closet combination shall not exceed 3.5 gallons per flush for floor outlet water closet; flush valve shall be factory set at 3.5 gallons per flush. Water closet top of seat height above floor shall be 17 to 19 inches. Provide white solid plastic elongated open-front seat with cover. Seat shall not be sprung to return to a lifted position.

2.4.2 Wall Hung Lavatory (LAV-1)

Designed for use by individuals with physical disabilities. ASME A112.19.2M, white vitreous china, straight back type, minimum dimensions of 18 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide ASME A112.6.1M concealed chair carriers with concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor.

2.4.3 Service Sinks (SSK-1)

ASME A112.19.2M, white vitreous china with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer.

2.4.4 Electric Drinking Fountains (DF-1)

Designed for use by individuals with physical disabilities. ARI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin and minimum knee clearance of 27 inches above floor. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed chair carriers.

2.4.5 Emergency Eyewash and Shower Equipment (SSH-1, SSH-2)

- a. SSH-1: ANSI Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.
- b. SSH-2: ANSI Z358.1, freeze-proof, floor supported free standing unit. Freeze-proof stay-open valve shall be operated by push plate and shall be buried below frost line to prevent freezing.

2.5 PLUMBING FIXTURE FAUCETS, TRIM, AND FITTINGS

ASME A112.18.1M for plumbing fixture faucets. The finish of plumbing

fixture faucets, trim, valves, and fittings exposed to view shall be chromium-plated or polished stainless steel except as modified herein. Handles may be clear plastic. Bolts, nuts, and screws shall be copper alloy or stainless steel. Provide globe valves or angle valves, and union connections in each supply to each faucet; chromium-plated finish is not required. Faucets shall be washerless type and shall have threaded type end connections, coupling nuts, or union connections. Faucets may be of the single control type. Provide washers and locknuts to secure faucets to lavatories and sinks.

- a. Traps: Provide P-traps for each plumbing fixture which does not have integral traps. Provide 1.5 inch white PVC adjustable P-traps and tubing with slip nuts and gaskets; chromium-plated finish is not required.
- b. Lavatory Faucets: Provide washerless faucets including aerators, drain outlets, and drain tail pieces for each lavatory. Provide perforated grid strainers for each lavatory. Faucet handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist; maximum force required to operate faucet handles shall be 5 pounds of force. Faucets for indicated wheelchair lavatories shall have gooseneck spout with aerator 5 inches above rim and shall have handles which open within one-quarter turn in opposite directions.
- c. Sink Faucets: Provide washerless faucets including swing spouts with aerators. Provide top mounted faucets for countertop sinks.
- d. Service Sink Faucets: Provide copper alloy back or wall mounted faucets with vacuum breaker and 0.75 inch external hose threads.

2.6 WATER HEATERS

2.6.1 WH-1 Water Heater (Tankless)

277V, single-phase, 8.0 kW to provide 1 gpm at 55-degree temperature rise. Wall mounted unit with UL rated cover, replaceable element, inlet filter, 0.5 gpm flow regulator, iron free element, 150 psi maximum operating pressure. Fully adjustable temperature range of 100 degrees F to 140 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil. Do not thread

metal pipe into plastic piping.

3.1.2 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for inline water pumps and flanged valves.

3.1.2.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 15080, "Mechanical Insulation."

3.1.2.2 Maximum Spacing Between Supports

- a. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support plastic and glass piping at each floor and at midpoint between floors, but at not more than 5 foot intervals.
- b. Horizontal Piping: Support cast-iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support plastic and glass piping at 4 foot intervals and support plastic piping at each change of direction. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Tube	6	7	8	8	9	10	11	12	13	14

3.1.3 Ductile Iron Pipe Aboveground

Provide flanged joints.

3.1.4 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes

through concrete floor slabs located on grade.

3.2 PLUMBING FIXTURES AND DRAINS

3.2.1 General

- a. Trap and vent each plumbing fixture as required by code.
- b. Install fixtures and drains true and plumb with separate stops for each fixture supply.
- c. Do not use galvanized nipples between copper water supply and angle stops.
- d. Install chrome-plated canopy flanges at each fixture drain where P-trap arm enters wall.

3.2.2 LAV-1, Lavatory

Insulate hot water and drainpipe under lavatory with a closed cell insulation, painted to match interior finish of room.

3.2.3 SSK-1, Service Sinks

Mount faucet 36 inches above finished floor.

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Lettering shall be minimum of 0.25 inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

- a. Manufacturer, type, and model number
- b. Contract number and accepted date
- c. Capacity or size
- d. System in which installed
- e. System which it controls

3.4 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service. Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Provide materials required to

make connections into the existing water supply systems and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.5 FIELD QUALITY CONTROL

3.5.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.5.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.5.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 120 psig with no leakage or reduction in gage pressure for 2 hours.

3.5.2.2 Sanitary Drain and Vent Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foothead of water. After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column. Perform the air and smoke test with an approved smoke testing machine which shall show a clear passage of smoke and air throughout the entire system. The entire system shall be proven absolutely tight under such test.

3.5.2.3 Backflow Preventers Test Report

Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

3.6 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping

GROUNDWATER REMEDIATION
SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

being placed into service. Disinfection of systems supplied by nonportable water is not required.

-- End of Section --

SECTION 15720

AIR HANDLING UNITS

12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

ANSI/AMCA 210	(1990) Testing Fans for Rating
AMCA 300	(1985; R 1987) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(1990) Calculating Fan Sound Ratings from Laboratory Test Data

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993; Rev. 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
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1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

a. Fans

Include sound rating data and sound power level for all octave-band center frequencies or loudness level.

1.3.2 SD-10, Test Reports

a. Corrosion protection

1.3.3 SD-12, Field Test Reports

a. Preliminary tests

b. Air handling and distribution equipment tests

Include certification by the equipment manufacturer's representative.

1.3.4 SD-19, Operation and Maintenance Manuals

a. Fans, Data Package 3

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.4 TESTING FOR CORROSION PROTECTION

Comply with ASTM A 123, or protect equipment with a corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B 117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D 1654.

1.4.1 Corrosion Criteria

Upon completion of exposure, evaluate coating or painting in accordance with ASTM D 1654. Coat or paint shall show no indication of deterioration, loss of adhesion, or indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.

1.4.2 Thickness of Coating

Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

PART 2 PRODUCTS

2.1 FANS

Total sound power level of the fan shall not exceed 90 dBA when tested per AMCA 300 and rated per AMCA 301; statically and dynamically balanced, with air capacities, brake horsepower, fan types, fan arrangement, sound power levels or loudness level, and static pressure as indicated. Fan bearing

life shall have a minimum average life of 200,000 hours at design operating conditions. Provide nominal 2 mesh 0.063 inch wire diameter, aluminum bird screens for outdoor inlets. Equip with (backdraft) dampers where indicated. Have thermal overload protection in the operating disconnect switches within the building. Construct housings and impellers of aluminum, except as specified otherwise. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70.

2.1.1 Propeller Fans

ANSI/AMCA 210 with AMCA seal, V-belt drive motors. Furnish fans with a three-conductor neoprene-covered flexible cable, (Type SO), and a three-prong attachment plug. Provide for connection of permanent wiring. Provide shaped steel or steel reinforced aluminum blade impeller with heavy hubs, statically and dynamically balanced, keyed and locked to shaft.

2.2 MOTORS AND MOTOR STARTERS

NEMA MG 1, NEMA ICS 2, and NEMA ICS 6, respectively, with electrical characteristics as indicated. Motors shall be open. Motor starters shall be magnetic-across-the-line type with general-purpose enclosure.

PART 3 EXECUTION

3.1 PREPARATION

Provide storage for equipment and materials at the project site. Parts shall be readily accessible for inspection, repair, and renewal. Protect materials and equipment from weather.

3.2 INSTALLATION

Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform with NFPA 70 and Division 16, "Electrical." Provide overload protection in the operating disconnect switches and magnetic starters. Locate air intake of air handling equipment at a minimum of 25 feet from industrial stacks, bathroom vents, and sanitary risers. Prevailing wind direction shall not be used as justification for placing air intake closer than 25 feet of exhaust stacks. Locate annunciator panel in maintenance office or foreman's office.

3.2.1 Fans

Install with resilient mountings, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork. Provide adjustable sheaves required for final air balance and safety screen where inlet or outlet is exposed.

3.3 FIELD QUALITY CONTROL

Schedule and administer specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the Contracting Officer ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Contracting Officer.

3.3.1 Inspection

Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

3.3.2 Preliminary Tests

For each item of air handling and distribution equipment and its components, perform an operational test for a minimum period of 4 hours.

3.3.3 Testing and Balancing

After preliminary tests, perform air handling tests, adjustment, and balancing in accordance with Section 15950, "HVAC Testing/Adjusting/Balancing".

-- End of Section --

SECTION 15730

UNITARY AIR CONDITIONING EQUIPMENT

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI DCUHP Directory of Certified Air-Source Units
Heat Pump Equipment

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING
ENGINEERS, INC. (ASHRAE)

ASHRAE 15 (1994; Errata 1995) Safety Code for
Mechanical Refrigeration

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.22 (1989) Wrought Copper and Copper Alloy
Solder Joint Pressure Fittings

ASME/ANSI B31.5 (1992; Errata 1993) Refrigeration Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989; Rev. A) Zinc (Hot-Dip Galvanized)
Coatings on Iron and Steel Products

ASTM B 88 (1995) Seamless Copper Water Tube

ASTM B 117 (1994) Operating Salt Spray (Fog) Testing
Apparatus

ASTM B 280 (1995) Seamless Copper Tube for Air
Conditioning and Refrigeration Field
Service

ASTM D 1654 (1992) Evaluation of Painted or Coated
Specimens Subjected to Corrosive
Environments

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze
Welding

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50502 Air Conditioners, (Unitary Heat Pump), Air

to Air (3,000 to 300,000 BTU)

FEDERAL SPECIFICATIONS (FS)

- FS OO-A-373 (Rev. C) (Int Am. 1) Air Conditioners, Single Package Type
- FS OO-A-374 (Rev. C) Air Conditioners with Remote Condensing Units or Remote Air-Cooled, and Water-Cooled Condenser Units, Unitary

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

- MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture
- MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA ICS 1 (1993) Industrial Control and Systems
- NEMA ICS 2 (1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
- NEMA ICS 6 (1993) Industrial Control and Systems Enclosures
- NEMA MG 1 (1993; Rev. 1-2) Motors and Generators

UNDERWRITERS LABORATORIES INC. (UL)

- UL 109 (1993; Bul. 1994) Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
- UL 873 (1994; Bul. 1995) Temperature-Indicating and -Regulating Equipment

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Heat pumps, air to air
- b. Filters

- c. Thermostats
- d. Refrigerant piping and accessories

1.3.2 SD-04, Drawings

- a. Field-assembled refrigerant piping
- b. Control system wiring diagrams

1.3.2.1 Detail Drawings

For refrigerant piping, submit piping, including pipe sizes. Submit control system wiring diagrams.

1.3.3 SD-06, Instructions

- a. Heat pumps, air to air
- b. Filters
- c. Thermostats
- d. Refrigerant piping and accessories

1.3.4 SD-11, Factory Test Reports

- a. Salt-spray tests

1.3.5 SD-12, Field Test Reports

- a. Start-up and initial operational tests

1.3.6 SD-18, Records

- a. Posted operating instructions

1.3.6.1 Posted Operating Instructions

Submit posted operating instructions for each packaged air conditioning unit.

1.3.7 SD-19, Operation and Maintenance Manuals

- a. Heat pumps, air to air, Data Package 3
- b. Filters, Data Package 2
- c. Thermostats, Data Package 2

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions

to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ASHRAE 15.

1.5 REFRIGERANTS

Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme.

PART 2 PRODUCTS

2.1 HEAT PUMPS, AIR TO AIR

CID A-A-50502, except as modified in this article; Type II, Class 1. List units with capacities smaller than 135,000 Btu/hr in the ARI DCUHP; in lieu of listing in the ARI Directory, a letter of certification from ARI that the units have been certified and will be listed in the next Directory will be acceptable. Provide factory assembled units complete with accessories, wiring, piping, and controls. Provide units with supplemental electric heaters, air filters as specified in the paragraph entitled "Filters."

2.1.1 Energy Performance

In accordance with CID A-A-50502.

2.1.2 Air Coils

Extended-surface fin and tube type with seamless copper tubes with aluminum fins securely bonded to the tubes.

2.1.3 Supplemental Electric Heaters

Provide electrical resistance heaters integral with the unit. Heaters shall have a total capacity as indicated. Provide internal fusing for heaters.

2.1.4 Compressors

Provide compressors with devices to prevent short cycling when shutdown by safety controls. Provide reciprocating compressors with crankcase heaters, and vibration isolators.

2.1.5 Mounting Provisions

Provide units that permit mounting as indicated. Provide suitable lifting attachment plates to enable equipment to be lifted to normal position.

2.1.6 Temperature Controls

Provide indoor thermostats of the adjustable type that conform to

applicable requirements of UL 873. Provide manual means for temperature set-back. Provide thermostats capable of controlling supplemental heat. Provide a manual selector switch or other means to permit the supplementary heater to be energized when the heat pump compressor and associated equipment are inoperative. Control supplementary heater with the room thermostat while bypassing the outdoor thermostat. Locate switch adjacent to or as an integral part of the room thermostat. An indicator light on the room thermostat or manual heat switch shall indicate when supplementary heaters are operating.

2.1.7 Accessories

In addition to accessories specified in CID A-A-50502, provide the following accessories for heat pump units.

- a. Protective grille around outside unit coils
- b. Start capacitor kit

2.2 MOTORS AND STARTERS

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide reduced voltage type motor starters. Provide general-purpose type starter enclosures in accordance with NEMA ICS 6.

2.3 REFRIGERANT PIPING AND ACCESSORIES

Provide accessories as specified in this section. Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. Provide a filter-drier in the liquid line.

2.3.1 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to ASHRAE 15 and ASME/ANSI B31.5, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to ASTM B 88, except that tubing with outside diameters of 1/4 inch and 3/8 inch shall have nominal wall thickness of not less than 0.030 inch and 0.032 inch, respectively. Soft annealed copper tubing conforming to ASTM B 280 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

2.3.2 Fittings

ASME/ANSI B16.22 for solder-joint fittings. UL 109 for flared tube fittings.

2.3.3 Brazing Filler Material

AWS A5.8.

2.3.4 Pipe Hangers and Supports

MSS SP-69 and MSS SP-58, except as indicated otherwise.

2.3.5 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

2.3.5.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above finished floor.

2.3.5.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 0.90 pound per square foot, in partitions and other than masonry and concrete walls, floors, and roofs.

2.4 FINISHES

Provide steel surfaces of equipment including heat pumps that do not have a zinc coating conforming to ASTM A 123, or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.5 SOURCE QUALITY CONTROL

2.5.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including heat pumps in accordance with ASTM B 117. Conduct test for 500 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D 1654.

Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install

equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.1 Unitary Air Conditioning System

Install as indicated, in accordance with requirements of ASHRAE 15, and the manufacturer's installation and operational instructions.

3.2 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME/ANSI B31.5.

3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP-69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58.

3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME/ANSI B31.5.

3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with FS 00-A-373, FS 00-A-374, and CID A-A-50502 when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 50 cubic inches and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.

3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.2.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 15400, "Plumbing Systems."

3.4 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

3.5 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air.

3.6 FLASHING AND PITCH POCKETS

Provide flashing and pitch pockets for equipment supports and roof penetrations and flashing where piping or ductwork passes through exterior walls in accordance with Section 13121, "Preengineered Metal Buildings."

3.7 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 1/8 inch high.

3.8 FIELD QUALITY CONTROL

3.8.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ASHRAE 15, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.8.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.8.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

-- End of Section --

SECTION 15810

DUCTWORK AND DUCTWORK ACCESSORIES
12/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 501 (1985) Application Manual for Air Louvers

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605.2 (1992) Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M (1994) Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process

ASTM C 553 (1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM E 437 (1992) Industrial Wire Cloth and Screens (Square Opening Series)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS (1985) HVAC Duct Construction Standards - Metal and Flexible

SMACNA FGDCS (1992) Fibrous Glass Duct Construction Standards

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 PRESSURE CLASSIFICATION

SMACNA DCS, Section 1, and as indicated.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-02, Manufacturer's Catalog Data

- a. Dampers
- b. Louvers
- c. Bird screens
- d. Diffusers, registers, and grilles
- e. Metal ducts

1.4.2 SD-07, Schedules

- a. Registers

Submit a schedule of inlets indicating location, catalog model number, manufacturer, dimensional information, sound pressure level rating, nominal rated volumetric flow rate (cfm), neck or face velocity at specified cfm, pressure drop at specified cfm.

1.5 QUALITY ASSURANCE

1.5.1 Modification of References

SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

PART 2 PRODUCTS

2.1 METAL DUCTS

2.1.1 Steel Ducts

ASTM A 653/A 653M galvanized steel sheet, lock-forming quality; coating designation G90.

2.2 DUCTS OF PRESSURE CLASSES 3 INCH WATER GAGE OR LESS

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

2.2.1 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap-lock," may be used in lieu of Pittsburgh Lock.

2.2.2 Fittings

Transitions, volume dampers, and flexible connections shall conform with SMACNA DCS, Section 2.

2.3 REGISTERS

2.3.1 Material and Finishes

Provide factory-furnished registers constructed of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc phosphate treated prior to priming and painting or have a baked-on enamel finish. Colors shall be selected or approved by Contracting Officer.

2.3.2 Registers

Provide manufacturer-furnished volume dampers. Volume dampers shall be of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Provide transfer registers with a single set of nondirectional face bars.

2.4 TROFFERS

2.4.1 Interior Dampers

Black paint or anodized.

2.5 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

2.5.1 Duct Sleeves

Fabricate from minimum 20 gage aluminum. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.

2.5.2 Prepared Openings

Provide one inch clearance between the duct and the sleeve, or one inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.

2.5.3 Packing

ASTM C 553, Type 1, Class B-2, mineral fiber.

2.5.4 Closure Collars

Four inches wide minimum, fabricated from minimum 20 gage galvanized steel.

2.6 ACCESS DOORS

Door shall be rigid and airtight with neoprene gaskets and two or more galvanized steel hinges and quick fastening locking devices. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

2.7 DAMPERS AND LOUVERS

Construct louvers with aluminum two gages heavier than ducts in which installed. Except as modified herein, the construction shall be of aluminum steel with interlocking edges and maximum 10 inch blade width. Conform with SMACNA DCS.

2.7.1 Manual Volume Dampers

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are furnished, provide chrome plated or enamel painted type with exposed edges rounded.

2.7.2 Louvers

Fixed dual drainable type, extruded aluminum, 4 inches deep. Fold or bead the edges of louver blades to 45 degrees to exclude driving rain. Louvers blades shall be oriented to minimize the entrainment of rainwater. Make louver frames of aluminum 0.081-inch thick. Provide bird screen constructed of the same type metal as the louvers. Finish shall be a minimum 1 mil thick full strength 70 percent resin fluoropolymer coating. The coating shall meet or exceed all requirements of AAMA specification AAMA 605.2.

2.7.2.1 Bird Screens

ASTM E 437, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 2 mesh 0.063 inch wire diameter, aluminum bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to NFPA 90A, SMACNA DCS and SMACNA FGDCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

3.1.1 Ductwork

Air distribution systems shall operate with no chatter or vibration.

3.1.1.1 Field Changes to Ductwork

Those required to suit the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.

3.1.1.2 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.

3.1.1.3 Duct Sleeves, Prepared Openings, and Closure Collars

Provide for ductwork penetrations in floors, walls, and partitions through which metallic ductwork passes.

- a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
- b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
- c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6 inch centers on collars.

3.1.1.4 Packing

Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber.

3.1.2 Duct Hangers and Supports

SMACNA DCS, Section 4. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing.

3.1.2.1 Flexible Connectors

Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.

3.1.3 Flashing

Section 13121, "Preengineered Metal Buildings." Provide waterproof flashing where ducts pass through exterior walls and roofs.

3.1.4 Cleaning of Ducts

Remove all debris and dirt from ducts and wipe clean. Before installing

air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust. Provide temporary air filters to protect ductwork which may be harmed by excessive dirt. For large systems, clean duct with high power vacuum machines.

-- End of Section --

SECTION 15950

HVAC TESTING/ADJUSTING/BALANCING

06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) Testing and Balancing Heating, Ventilating and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB CMSV (1993) Calculations and Measurements of Sound and Vibration

NEBB TABES (1991) Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA HVACTAB (1993) HVAC Systems Testing, Adjusting and Balancing

1.2 DESCRIPTION OF WORK

The work includes testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.2.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems under Section 15080, "Mechanical Insulation."

1.3 DEFINITIONS

- a. DALT: Duct air leakage testing
- b. DALT'd: Duct air leakage tested
- c. Sound measurements terminology: Defined in AABC MN-1 or NEBB CMSV.
- d. TAB team supervisor: TAB team engineer.
- e. TAB team technician: TAB team assistant.

- f. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system."
- g. Out-of-tolerance data: Pertains only to field checking of certified DALT or TAB report. The term is defined as a measurement taken during field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified DALT or TAB report for a specific parameter.
- h. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated winter outdoor design dry bulb temperature plus 30 to minus 30 degrees Fahrenheit.
- i. Season of maximum cooling load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated summer outdoor design dry bulb temperature plus 15, minus 5 degrees Fahrenheit.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.4.1 SD-08, Statements

- a. Independent TAB agency personnel qualifications
- b. Design review report
- c. Pre-field TAB engineering report
- d. Advanced notice for Season 1 TAB field work
- e. Check out list for Season 1
- f. Advanced notice for Season 2 TAB field work
- g. Check out list for Season 2

1.4.1.1 Independent TAB Agency Personnel Qualifications

Submit the following, for the agency, to Contracting Officer for approval in compliance with paragraph entitled "TAB Personnel Qualification Requirements."

- a. Independent AABC or NEBB certified TAB agency:
 - (1) TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification.
 - (2) TAB team supervisor: Name and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification.

(3) TAB team field leader: Name and documented evidence that the team field leader meets the qualification requirements.

(4) TAB team field technicians: Names and documented evidence that each field technician meets the qualification requirements.

(5) Current certificates: Registrations and certifications shall be current, and valid for the duration of this contract. Certifications which expire prior to completion of the TAB work, shall be renewed in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification shall not perform TAB work on this contract.

- b. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.4.1.2 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.4.1.3 Pre-Field TAB Engineering Report

Submit report containing the following information:

- a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

- b. Pre-field data: Submit AABC or NEBB or SMACNA HVACTAB data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each

TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. The instrument key number shall be placed in the blank space where the measured data would be entered.

1.4.1.4 Advanced Notices

- a. Submit "Advanced Notice for Season 1 TAB Field Work" in writing.
- b. Submit "Advanced Notice for Season 2 TAB Field Work" in writing.

1.4.1.5 Completed Check Out Lists

- a. Check out list for Season 1
- b. Check out list for Season 2

Submit "Prerequisite HVAC Work Checkout List" and certify in writing that each item has been checked and is operating as designed.

1.4.2 SD-12, Field Test Reports

- a. Certified TAB report for Season 1
- b. Certified TAB report for Season 2

Submit certified reports in the specified format including the above data.

1.4.2.1 Certified TAB Reports

Submit Certified TAB Report for Season 1 and Certified TAB Report for Season 2 in the following manner:

- a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.
- b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded.
- c. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.
- d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.4.3 TAB Submittal and Work Schedule

Compliance with the following schedule is the Contractor's responsibility.

1. Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.
2. Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.
3. Season 1 Checklist and Notice of TAB Work: At a minimum of 90 calendar days prior to CCD, submit Season 1 prerequisite HVAC work checklist certified as complete, and submit advance notice of commencement of Season 1 TAB field work.
4. Season 1 TAB Field Work: At a minimum of 30 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.
5. Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit certified Season 1 TAB report.
6. Season 1 TAB Field Check: 30 calendar days after certified Season 1 TAB report is approved by the Contracting Officer, conduct Season 1 field data check.
7. Complete Season 1 TAB Work: Prior to CCD, complete all TAB work except Season 2 TAB work.
8. Season 2 Checklist and Notice of TAB Work: Within 150 calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work checklist certified as complete and submit advance notice of commencement of Season 2 TAB field work.
9. Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.
10. Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit certified Season 2 TAB report.
11. Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.
12. Season 2 TAB Field Check: 30 calendar days after the certified Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field data check.
13. Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 field data check, complete all TAB work.

1.5 QUALITY ASSURANCE

1.5.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design

Engineer" to mean the "Contracting Officer."

1.5.2 TAB Personnel Qualitification Requirements

1.5.2.1 Independent AABC or NEBB Certified TAB Agency

Provide services of a TAB agency certified by AABC or NEBB to perform and manage TAB work on HVAC air and water systems. This TAB agency shall not be affiliated with any company participating in any other phase of this contract, including design, furnishing equipment, or construction.

1.5.2.2 TAB Team Personnel

The TAB team approved to accomplish work on this contract shall be full-time employees of the TAB agency. No other personnel shall do TAB work on this contract.

- a. TAB Team Supervisor: Supervisor shall be qualified by AABC or NEBB as a TAB supervisor or a TAB engineer.
- b. TAB Team Field Leader: Leader shall have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.
- c. TAB Team Field Technician: Technician shall have satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

1.5.3 Responsibilities

The Contractor shall be responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.5.3.1 Contractor

- a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."
- b. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB Agency:
 - (1) Contract drawings and specifications
 - (2) Approved submittal data for equipment
 - (3) Construction work schedule
 - (4) Up-to-date revisions and change orders for the previously listed items
- c. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

- d. Coordination of supporting personnel: Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the TAB field measurement work. Provide equipment mechanics to operate HVAC equipment to enable TAB field team to accomplish the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the TAB field work.
- e. Deficiencies: Ensure that equipment defects, installation deficiencies, and design deficiencies reported by the TAB team field leader are brought to the attention of the Contracting Officer. Ensure that design deficiencies reported by the TAB field leader, or the TAB team supervisor, are transmitted to the Contracting Officer within 4 calendar days from date of receipt from the TAB agency.
- f. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. List as prerequisite work items, the deficiencies, pointed out by the TAB team supervisor in the design review report. Ensure that the TAB Agency gets a copy of the prerequisite HVAC work checklist specified in the paragraph entitled "Submittals." Do not allow the TAB team to commence TAB field work until all of the following are completed.
 - (1) HVAC system installations are fully complete.
 - (2) HVAC prerequisite checkout work lists have been completed, submitted, and approved.
 - (3) DALT field checks for all systems are completed.
 - (4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.
- g. Advance notice: Furnish to the Contracting Officer with advance written notice for each event, the commencement of the TAB field work.

1.5.3.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "TAB Personnel Qualification Requirements."

1.5.3.3 TAB Team Supervisor

- a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.
- b. Pre-TAB meeting: Attend meeting with Contractor.

- c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
- d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the pre-field DALT plan or during the DALT or TAB field work.
- e. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.
- f. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.
- g. Technical assistance for DALT work
 - (1) Technical assistance: Provide immediate technical assistance to TAB field team.
- h. Certified DALT report: Certify the DALT report. This certification includes the following work:
 - (1) Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.
- i. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
 - (1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8-hour workdays duration.
- j. Certified TAB report: Certify the TAB report. This certification includes the following work:
 - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
 - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
- k. Design deficiencies: Submit in writing as soon as possible, to the Contractor and the Contracting Officer, each design deficiency

reported by the TAB field team. Provide, in this submittal, a complete explanation including supporting documentation detailing the deficiency.

1. TAB Field Check: The TAB team supervisor shall attend and supervise Season 1 and Season 2 TAB field check.

1.5.3.4 TAB Team Field Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
- c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TAB PROCEDURES

3.1.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Air systems and water systems shall be proportionately balanced and reported in the Season 1 certified TAB report. Only water and airflow report data which would be affected in terms of accuracy due to outside ambient conditions shall be deferred and reported in the Season 2 certified TAB report. Provide instruments and consumables required to accomplish the TAB work.

- a. Maintenance and calibration of instruments.
- b. Accuracy of measurements.
- c. Preliminary procedures: Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the sheetmetal contractor to provide and install test ports as required by the TAB engineer.
- d. Air distribution systems TAB work:
 - (1) Air handling unit systems including fans (fans, exhaust fans and winter ventilation fans).
 - (2) Cooling units.
 - (3) Unit heaters.

- e. TAB work on performance tests:
 - (1) Performance tests: In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.
 - (2) Ambient temperatures: On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.
 - (3) Refrigeration units: For all refrigeration compressors/condensers/condensing units all data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.
- f. TAB work within seasonal limitations:
 - (1) Season of maximum load: Visit the contract site for at least one TAB work sessions for TAB field measurements. Visit the contract site during the season of maximum heating load and visit the contract site during the season of maximum cooling load, the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.
 - (2) Ambient temperatures: On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.
 - (3) Refrigeration units: For all refrigeration compressors/condensers/condensing units all data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.
- g. Workmanship: Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.
- h. Deficiencies: Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction. Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is

in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.1.2 Data From TAB Field Work

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

3.1.3 Quality Assurance For TAB Field Work

- a. Field check: Test shall be made to demonstrate that capacities and general performance of air and water systems comply with the contract requirements.

(1) Recheck: During field check, the Contractor shall recheck, in the presence of the Contracting Officer, random selections of data (water, air quantities, air motion, sound level readings) recorded in the certified report.

(2) Areas of recheck: Points and areas of recheck shall be selected by the Contracting Officer.

(3) Procedures: Measurement and test procedures shall be the same as approved for work for forming basis of the certified report.

(4) Recheck selections: Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

- b. Retests: If random tests reveals a measured quantity which is out-of-tolerance, the report is subject to disapproval at the Contracting Officers discretion. In the event the report is disapproved, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and a new field check conducted at no additional cost to the Government.

- c. Approval prerequisite: Compliance with the field checking requirements of this section is a prerequisite to the final approval of the certified TAB report submitted.

3.2 MARKING OF SETTINGS

Permanently mark the settings of HVAC adjustment devices including valves so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

-- End of Section --

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709 (1992) Laminated Thermosetting Material

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100 (1992) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Construction," Division 11, "Equipment," Division 13, "Special Construction," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 7.2 kV primary, three phase, three wire, 60 Hz, and 480 volts secondary, three phase, three wire. Final connections to the power distribution system at the existing Pole No. 253B shall be made by the Contractor as directed by the Contracting Officer.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of section entitled "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 14 inches by 20 inches in size using a minimum scale of 1/8 inch per foot[, except as specified otherwise]. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for

rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01781, "Operation and Maintenance Data" and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or

brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in

approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, transformers, generators, and switchgear having a nominal rating exceeding 600 volts. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 inches by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

1.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The first position on the tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. Tag legend shall be as indicated. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.10.2 Lead Cable Tags

Provide tags of virgin sheet lead, one-piece wraparound strap type, slotted

on one end for attaching the strap. Minimum size of tags shall be one inch wide by 3/64 inch thick and a length sufficient for die stamping the identification on one line and banding around the cable or wire, but not less than 10 inches long. Tags shall be die stamped with numbers, letters, and symbols not less than 0.25 inch high and approximately 0.015 inch deep in normal block style.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment, except controllers indicated as part of the motor control centers shall be provided under Section 16402, "Interior Distribution System". Motors, controllers, integral disconnects, and contactors shall conform to Section 16402, "Interior Distribution System". Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated. As an exception to these requirements, provide disconnect switches, contactors, and controllers for existing motor-operated equipment under Section 16402, "Interior Distribution System."

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment[, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment] under Section 16402, "Interior Distribution System." Power wiring and conduit shall conform to Section 16402, "Interior Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the

changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test [and the additional requirements specified in the technical sections].

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in [Section 09900, "Paints and Coatings"] [the section specifying the associated electrical equipment].

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

-- End of Section --

SECTION 16081

APPARATUS INSPECTION AND TESTING
12/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS

(1991) Electrical Power Distribution
Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-08, Statements

- a. Qualifications of organization, and lead engineering technician G
- b. Acceptance test and inspections procedure G

1.3.1.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.
- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for

Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.3.1.2 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

1.3.2 SD-12, Field Test Reports

a. Acceptance tests and inspections G

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

- a. Section 16272, "Three-Phase Pad-Mounted Transformers"
- b. Section 16303, "Underground Electrical Work"

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

-- End of Section --

SECTION 16272

THREE-PHASE PAD-MOUNTED TRANSFORMERS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|----------------|---|
| ANSI C2 | (1997) National Electrical Safety Code |
| ANSI C37.47 | (1981; Supp. 1983, Correction 1984, R 1992) Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses |
| ANSI C57.12.28 | (1988; Correction 1988) Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|---|
| ASTM A 167 | (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM D 117 | (1989) Electrical Insulating Oils of Petroleum Origin |
| ASTM D 1535 | (1995; Rev. B) Specifying Color by the Munsell System |
| ASTM D 3487 | (1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

- | | |
|----------------|--|
| IEEE 386 | (1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V |
| IEEE C57.12.26 | (1992) Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller) |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

- | | |
|----------|--------------------------------------|
| NETA ATS | (1991) Electrical Power Distribution |
|----------|--------------------------------------|

Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|----------|---|
| NFPA 70 | (1996) National Electrical Code |
| NFPA 70B | (1994) Electrical Equipment Maintenance |

UNDERWRITERS LABORATORIES INC. (UL)

- | | |
|--------|---|
| UL 467 | (1993; Bul. 1994 and 1996, R 1996)
Grounding and Bonding Equipment |
|--------|---|

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," and Section 16081, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract. Code 404, Atlantic Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval. As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be required:

- a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.
- b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a), single copy for information only.
- c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b), single copy for information only.
- d. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may be witnessed by the government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.
- e. Provide field test reports (paragraph entitled "Field Test Reports").
- f. Provide operation and maintenance manuals (paragraph entitled "Operation and Maintenance Manuals").

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Pad-mounted transformers G

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

1.3.2 SD-04, Drawings

- a. Pad-mounted transformer drawings G

1.3.2.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

- a. An outline drawing, with front, top, and side views.
- b. ANSI nameplate data.
- c. Elementary diagrams and wiring diagrams.
- d. One-line diagram, including switch(es), current transformers, and fuses.
- e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuse.

1.3.3 SD-11, Factory Test Reports

- a. Pad-mounted transformer design tests G
- b. Pad-mounted transformer routine and other tests G

1.3.4 SD-12, Field Test Reports

- a. Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control" G
- b. Ground resistance test reports G

1.3.4.1 Ground Resistance Test Reports

Upon completion and before energizing electrical equipment, submit the measured ground resistance of grounding system. Include a description of the soil conditions at the time the measurements were taken.

1.3.5 SD-19, Operation and Maintenance Manuals

- a. Pad-mounted transformer(s), Data Package 5 G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein.

1.3.5.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual pad-mounted transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports

- e. Fuse curves for primary fuses
- f. Actual nameplate diagram
- g. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 16303, "Underground Electrical Work," and Section 16402, "Interior Distribution System".

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.26 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to dry-well fuse canisters, tap changer handle, connector parking stands, and ground pad.

- a. Insulated high-voltage load-break connectors: IEEE 386, rated 7.5 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.
- b. Bushing well inserts and feed-thru inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.
- c. Load-break switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.
- d. Current-limiting fuses, dry-well mount: ANSI C37.47. Provide fuses in air-insulated, oil-sealed, dead-front, non-load-break dry-well fuse canisters, on the load side of the load-break switch serving the transformer. Interlock fuse canisters with the load-break switch so that the fuses may be removed and inserted only when the switch is in the "Off" position. Fuses shall remove

the transformer from service in case of an internal fault. Size fuses to approximately 150 percent of the transformer primary full load current rating and in accordance with fuse manufacturer's recommendations for dry-well mounting. Fuses shall have an interrupting rating of 50,000 rms amperes symmetrical at the system voltage specified. Furnish a spare fuse for each fuse provided.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel diagrammatic transformer nameplate, and ground pad.

- a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.
- b. Provide 2 circuit breakers mounted in a separate molded case circuit breaker panel on transformer. Circuit breakers will feed secondary loads at existing building no. 148 and MCC1, respectively.

2.2.2 Insulating Liquid

- a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

2.2.3 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Form cabinets of stainless steel sheets no less than No. 13 U.S. gage. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with ANSI C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.3 WARNING SIGNS

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 16303, "Underground Electrical Work". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 16303, "Underground Electrical Work."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2-inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant calking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete."

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

- (1) Compare equipment nameplate information with approved shop drawings

(2) Inspect for physical damage, cracked insulators, leaks, tightness of connections, and general mechanical and electrical conditions

(3) Verify proper liquid level in tank

(4) Perform specific inspections and mechanical tests as recommended by manufacturer

(5) Verify proper equipment grounding

b. Electrical tests

(1) Perform insulation-resistance tests

(2) Perform turns-ratio tests

(3) Sample insulating liquid. Sample shall be laboratory tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d) Interfacial tension

(e) Color

(f) Visual condition

(g) Power factor

(h) Water content

(4) Perform dissolved gas analysis (DGA)

(5) Test for presence of PCB

3.5.1.2 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the three-point method

3.5.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer

shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16303

UNDERGROUND ELECTRICAL WORK
03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315 (1994) Details and Detailing of Concrete Reinforcement

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1997) National Electrical Safety Code

ANSI C119.1 (1986) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1 (1995) Hard-Drawn Copper Wire

ASTM B 8 (1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM C 32 (1993) Sewer and Manhole Brick (Made from Clay or Shale)

ASTM C 478 (Rev A, 1995) Precast Reinforced Concrete Manhole Sections

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS6 (1987; R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69 kV

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621 (Rev. E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 48 (1996) 2.5 kV through 765 kV, Alternating-Current Cable Terminations

IEEE 404 (1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138,000 V and Cable Joints for Use with

Laminated Dielectric Cable Rated 2500 V
Through 500,000

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (1991) Electrical Power Distribution
Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1 (1989) Polyvinyl-Chloride (PVC) Externally
Coated Galvanized Rigid Steel Conduit and
Intermediate Metal Conduit

NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct
for Underground Installation

NEMA TC 9 (1990) Fittings for ABS and PVC Plastic
Utilities Duct for Underground
Installation

NEMA WC 8 (1988; R 1992)
Ethylene-Propylene-Rubber-Insulated Wire
and Cable for the Transmission and
Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70B (1994) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES INC. (UL)

UL 6 (1993; Bul. 1993) Rigid Metal Conduit

UL 83 (1991; Bul. 1991, 1993, 1994, 1995, Rev.
1996) Thermoplastic-Insulated Wires and
Cables

UL 467 (1993; Bul. 1994, Rev. 1996) Grounding and
Bonding Equipment

UL 486A (1991; Errata 1991 and 1992; Bul. 1993
1994, and 1995) Wire Connectors and
Soldering Lugs for Use with Copper
Conductors

UL 510 (1994) Polyvinyl Chloride, Polyethylene,
and Rubber Insulating Tape

UL 514A (1991; Bul. 1993 and 1994) Metallic Outlet
Boxes

UL 514B (1989; Errata 1991; Bul. 1993 and 1994)
Fittings for Conduit and Outlet Boxes

UL 854 (1996) Service-Entrance Cables

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods" and Section 16081, "Apparatus Inspection and Testing" apply to this section with additions and modifications specified herein.

1.2.1 Underground Service

Terminate underground service into building at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the service to the service entrance equipment is included in Section 16402, "Interior Distribution System." Protect ends of underground conduit with threaded metal caps or plastic plugs as applicable until connections are made.

1.3 DEFINITIONS

- a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.
- b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the basic contract.

1.4.1 SD-02, Manufacturer's Catalog Data

- a. Medium voltage cable G
- b. Medium voltage cable terminations G

1.4.2 SD-04, Drawings

- a. Precast manhole G Submittal required for each type used.
- b. Pulling-in irons G
- c. Frames and covers G

1.4.2.1 Precast manhole

Provide calculations and drawings for precast manholes bearing the seal of a registered professional engineer including:

1. Material description (i.e., f'c and Fy)
2. Manufacturer's printed assembly and installation instructions
3. Design calculations
4. Reinforcing shop drawings prepared in accordance with ACI 315
5. Plans and elevations showing opening and pulling-in iron locations and details

1.4.3 SD-08, Statements

- a. Cable splicer/terminator G

1.4.3.1 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.4 SD-09, Reports

- a. Arc-proofing test for cable fireproofing tape G
- b. Medium voltage cable qualification and production tests G

1.4.4.1 Arc-Proofing Test for Cable Fireproofing Materials

Manufacturer shall test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2-inch outside diameter, and a 1/8-inch thick wall, and covered with one-half lap layer of arc and fireproofing material per manufacturer's instructions. The arc and fireproofing tape shall withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode shall be obtained from a DC power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc shall be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly shall be tested at three unrelated points. Start time for tests shall be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time shall be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape shall indicate that the test has been performed and passed by the manufacturer.

1.4.4.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS5 and AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

1.4.5 SD-12, Field Test Reports

- a. Field Acceptance Checks and Tests G

Identify each cable for 600-volt, and medium voltage cable tests. When

testing grounding electrodes and systems, identify each electrode and system for each test, as well as the resistance and soil conditions at the time the measurements were made.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.2 Plastic Utilities Duct for Concrete Encasement

NEMA TC 6, Type EB.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514B, threaded type.

2.1.2.2 PVC Duct Fittings

NEMA TC 9.

2.1.2.3 Outlet Boxes for PVC Coated Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.1.3 Conductors Rated 600 Volts and Less

Conductor sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

Service entrance and direct buried conductors shall conform to UL 854, Type USE. Conductors in conduit other than service entrance shall conform to UL 83, Type THWN. Conductor size and number of conductors in each cable shall be as indicated. Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be

stranded copper. All conductors shall be copper. Conductors No. 6 AWG and smaller shall be copper.

- a. Colors for coding conductors shall be:

208-VOLT SYSTEM

Neutral - White
Phase A - Black
Phase B - Red
Phase C - Blue
Grounding Conductor - Green

480-VOLT SYSTEM

Neutral - White
Phase A - Brown
Phase B - Orange
Phase C - Yellow
Grounding Conductor - Green

2.1.4 600 Volt Wire Connectors and Terminals

Shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

- a. For use with Copper Conductors: UL 486A.

2.1.5 600 Volt Splices

Provide splices with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

- a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.
- (1) Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.
- b. Provide heavy wall heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied by a clean burning propane gas torch.
- c. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as coverings or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.1.6 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery

to the site shall not be accepted.

Cable for 11.5 kV underground distribution system shall be Ozone resistant ethylene-propylene- rubber-insulated (EPR) cable conforming to NEMA WC 8, as applicable, and AEIC CS6. Cable shall be single conductor, employing concentric, Class B stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape type consisting of a concentric serving of tape according to NEMA WC 8. Cable shall be rated 15 kV with insulation and jacket thickness of 115 and 80 mils, respectively. Cable shall have a polyvinyl chloride jacket.

2.1.7 Medium Voltage Cable Terminations

IEEE 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. The terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor.

2.1.7.1 Indoor Terminations / Terminations Within Equipment Enclosures

The indoor terminator shall be cold-shrink type or heat shrinkable type.

a. Cold-Shrink Type

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree F, with an emergency overload temperature rating of 130 degree F.

b. Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material.

2.1.7.2 Outdoor Terminations

The outdoor terminator shall be cold shrink type or porcelain insulator type.

a. Cold-Shrink Type

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be

designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

b. Porcelain Insulator Type

The terminator shall comply with requirements of IEEE 48 Class 1, except that the requirements of design tightness test need not be met. However, the terminator shall not exude any insulating filler compound under either test or service. The terminator shall consist of a porcelain insulator, copper cable connector-hoodnut assembly and copper aerial lug as required, metal body and supporting bracket, sealed cable entrance, internal stress relief device for shielded cable, and insulating filler compound or material.

2.1.7.3 Termination; Separable Insulated Connector Type

Provide as specified in Section 16272, "Three-Phase Pad-Mounted Transformers."

2.1.8 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, and insulation type of the cable. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

- a. Watertight Taped-Type Joint: Consists of an approved connector, self-fusing or self-bonding insulating tape, self-fusing semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

2.1.9 Tape

2.1.9.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.9.2 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC CABLE or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.1.9.3 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick by 3 inches wide, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage,

and fungus.

2.1.10 Pull Rope

Shall be plastic having a minimum tensile strength of 200 pounds.

2.1.11 Grounding and Bonding Equipment

UL 467. Provide copper clad steel ground rods with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter. Ground rods shall be 10 feet long unless otherwise indicated.

2.1.12 Underground Structures

2.1.12.1 Precast Concrete Manholes, Risers and Tops

ASTM C 478, precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes.

2.1.12.2 Manholes

Provide type indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.1.12.3 Metal Frames and Covers

Provide cast iron frames and covers for manholes conforming to FS RR-F-621.

2.1.12.4 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

2.1.13 Cable Tags

Provide as specified in 16050, "Basic Electrical Materials and Methods."

PART 3 EXECUTION

3.1 INSTALLATION

Underground installation shall conform to ANSI C2 except as otherwise specified or indicated.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as

"Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psi minimum ultimate 28-day compressive strength with 1-inch minimum aggregate conforming to the requirements of Section 03300, "Cast-in-Place Concrete."

3.1.3 Underground Conduit/Duct Without Concrete Encasement

The type of conduit shall be PVC-coated rigid galvanized steel.

3.1.3.1 Conduit Installation

The top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed, draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4-inch sieve. Provide color, type and depth of warning tape as specified in paragraph "BURIED WARNING AND IDENTIFICATION TAPE" herein.

3.1.3.2 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3-inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place.

3.1.3.3 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.1.4 Underground Duct with Concrete Encasement

Construct underground duct banks of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC, Type EB. Do not mix different kinds of conduit in any one duct bank. Ducts shall be a minimum of 5 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover around ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches. Provide color, type and depth of warning tape as specified in paragraph "BURIED WARNING AND IDENTIFICATION TAPE" herein.

3.1.4.1 Depth of Encasement

The top of the concrete envelope shall be a minimum of 18 inches below grade, except under roads and pavement, concrete envelope shall be a minimum of 24 inches below grade.

3.1.4.2 Slope of Encasement

Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet. Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be composed of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

3.1.4.3 Conduit

Terminate conduits in end-bells where ducts enter underground structures. Stagger the joints of the conduits by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.4.4 Test Mandrel

As each section of a duct bank is completed from structure to structure, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff-bristled brush, having the diameter of the conduit shall be drawn through until the conduit is clear of earth, sand, and gravel particles. Conduit plugs shall then be immediately installed.

3.1.4.5 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.1.4.6 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have an enlarged cross-section at the manhole entrance to provide additional shear strength. The dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. The perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide for a positive interlock between the duct bank and the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.

3.1.4.7 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 1 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.1.5 Underground Conduit for Service Feeders Into Buildings

Shall be PVC, Type EPC-40 from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed. Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.1.6 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.7 Buried Warning and Identification Tape

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.8 Cast-In-Place Manholes

3.1.8.1 Pulling-In Irons

Pulling-in irons shall be steel bars bent as indicated by Sketch No. UG - 7, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other

types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6-inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3-foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.1.8.2 Grounding in Manholes

Provide a No. 1/0 AWG bare copper cable on each manhole sidewall. The cables shall be exothermically welded to the ground rod in the manhole, and shall be accessible for future grounding requirements.

3.1.8.3 Precast Manholes Installation

Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the manhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

3.1.8.4 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint. Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be given a crystalline phosphate coating. As soon as practicable after the coating has dried, surfaces shall be primed with a coat of zinc-molybdate primer and one coat of synthetic exterior gloss enamel.

3.1.9 Cable Pulling

Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use

flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.9.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.1.9.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.9.3 Cable Markers (or Tags) in Manholes

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

3.1.10 600 Volt Cable Splicing and Terminating

Provide splices and terminations to protect 600 volt insulated power and lighting cables from accidental contact, deterioration of coverings and moisture. Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set.

3.1.11 Medium Voltage Cable Terminations

Provide terminating devices and materials to protect medium voltage cable terminations from accidental contact, deterioration of coverings, and moisture. Make terminations by using materials and methods specified herein and as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE 48. Terminations of single- and multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.12 Medium Voltage Cable Joints

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods specified herein and as designated by the written instructions of the cable manufacturer and the joint kit manufacturer. Size connectors properly for the cable being connected and crimp using a full circle compression tool.

3.1.12.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice.

Provide a bare copper ground connection brought out in a watertight manner and grounded to a ground rod as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.1.13 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.14 Fireproofing of Cables in Manholes

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes.

3.1.14.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.1.15 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms
Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution systems and grounds not otherwise covered	5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

3.1.15.1 Grounding Electrodes

Provide cone pointed ground rods driven full depth plus 6 inches, installed

to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.15.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.15.3 Grounding Conductors

Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG, except 34.5 kV cable sheaths and cable shields shall be grounded with No. 4/0 AWG.

3.1.15.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.1.16 Excavating, Backfilling, and Compacting

Provide under this section as specified in Section 02315, "Excavation and Fill".

3.1.17 Reconditioning of Surfaces

3.1.17.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.17.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement to the same thickness and in the

same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 600 Volt Cable Tests

Perform tests after wiring is completed, connected, and ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed.

a. Visual and Mechanical Inspection

- (1) Inspect cables for physical damage and proper connection in accordance with contract plans and specifications
- (2) Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench; In the absence of manufacturer's data use NETA recommended values
- (3) Check cable color coding for compliance with contract specifications

b. Electrical Tests

- (1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors; Applied potential shall be 1000 volts DC for 1 minute; minimum insulation - resistance values shall not be less than 2 megohms
- (2) Perform continuity test to insure proper cable connection

3.2.1.2 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment

a. Visual and Mechanical Inspection

- (1) Inspect exposed cable sections for physical damage
- (2) Verify that cable is supplied and connected in accordance with contract plans and specifications
- (3) Inspect for proper shield grounding, cable support, and cable termination
- (4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius
- (5) Inspect for proper fireproofing

(6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices

(7) Visually inspect jacket and insulation condition

(8) Inspect for proper phase identification and arrangement

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method; Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage for 15 kV cable shall be 65 kV DC for cables without insulated connectors and 53 kV DC with insulated connectors.

(a) Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment

(b) Record wet- and dry-bulb temperatures or relative humidity and temperature

(c) Test each section of cable individually

(d) Individually test each conductor with all other conductors grounded; Ground all shields

(e) Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary

(f) Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or manufacturer's specifications.

(g) Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.

(h) Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (X axis) versus voltage (Y axis) at each increment

(i) Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.

(j) Apply grounds for a time period adequate to drain all

insulation stored charge.

(k) When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75% of new cable tested value.

3.2.1.3 Grounding System

a. Visual and Mechanical Inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical Tests

Perform ground-impedance measurements utilizing the three-point method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall.

3.2.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 16402

INTERIOR DISTRIBUTION SYSTEM

06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.7	(1993) Watthour Meter Sockets
ANSI C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanic
ANSI C12.16	(1991) Electricity Metering Solid-State Electricity Meters
ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA KS 1	(1990) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1993; Rev. 1-2) Motors and Generators
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC

	Conduit and Tubing
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA WD 1	(1983; R 1989) Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(1996) National Electrical Code
UNDERWRITERS LABORATORIES INC. (UL)	
UL 1	(1993; R 1993, Bul. 1994) Flexible Metal Conduit
UL 6	(1993; Bul. 1993) Rigid Metal Conduit
UL 50	(1995) Safety Enclosures for Electrical Equipment
UL 67	(1993; R 1995, Bul. 1994 and 1995) Panelboards
UL 83	(1991; Bul. 1991, 1993, 1994, and 1995, R 1995) Thermoplastic-Insulated Wires and Cables
UL 198C	(1986; Bul. 1991, 1992, 1993, and 1995, R 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988, Bul. 1991, 1992, and 1993) Class R Fuses
UL 198H	(1988; Bul. 1991, 1992, 1993, and 1994, R 1993) Class T Fuses
UL 360	(1986; Bul. 1991, R 1994) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Bul. 1994, R 1995) Grounding and Bonding Equipment
UL 486A	(1991; Errata 1991 and 1992, R 1992, Bul. 1993, 1994, and 1995) Wire Connectors and Soldering Lugs for Use With Copper Conductors
UL 489	(1991; Bul. 1992, 1993, 1994, and 1995, R 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1991; Bul. 1993, 1994, and 1995, R 1995) Attachment Plugs and Receptacles

GROUNDWATER REMEDIATION

SITE 1 - NORTHERN RIVERSIDE WASTE DISPOSAL AREA

05966834

UL 506	(1994; R 1994, Bul. 1994 and 1995) Specialty Transformers
UL 508	(1993; Bul. 1993, 1994, and 1995, R 1994) Industrial Control Equipment
UL 510	(1994; R 1994) Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1991; R 1993, Bul. 1993 and 1994) Metallic Outlet Boxes
UL 514B	(1989; Errata 1991, R 1993, Bul. 1993 and 1994) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 845	(1995; Bul. 1995) Motor Control Centers
UL 869	(1989; R 1991, Bul. 1992, 1993, and 1995) Service Equipment
UL 870	(1995) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; Bul. 1994 and 1995, R 1995) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; Bul. 1993, 1994, and 1995, R 1995) Ground-Fault Circuit-Interruption
UL 984	(1991) Hermetic Refrigerant Motor-Compressors
UL 1010	(1995) Receptacle-Plug Combination for Use in Hazardous (Classified) Locations
UL 1660	(1994) Liquid-Tight Flexible Nonmetallic Conduit

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract.

1.3.1 SD-02, Manufacturer's Catalog Data

- a. Receptacles G
- b. Circuit breakers G

- c. Switches G
- d. Transformers G
- e. Enclosed circuit breakers G
- f. Motor controllers G
- g. Combination motor controllers G
- h. Firestopping materials G
- j. Manual motor starters G
- k. Heat Trace G
- l. Metering G
- m. Adjustable frequency drives G
- n. Mini power centers G
- o. Disconnect switches G

1.3.2 SD-04, Drawings

- a. Panelboards G
- b. Transformers G
- c. Motor control centers G
- d. Wireways G
- e. Adjustable frequency drives G
- f. Mini power centers G

1.3.3 SD-08, Statements

- a. Fuses G

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.3.4 SD-12, Field Test Reports

- a. 600-volt wiring test G
- b. Grounding system test G
- c. Transformer tests G

1.3.5 SD-19, Operation and Maintenance Manuals

- a. Electrical Systems, Data Package 5

1.3.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), plastic coated rigid steel and IMC conduit, and flexible metal conduit, liquid-tight flexible conduit, conforming to the following:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.4 Flexible Metal Conduit

UL 1.

2.2.4.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.5 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance

with UL 514B.

2.2.5.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.5.2 Fittings for EMT

Steel compression type.

2.2.5.3 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.2.6 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.2.7 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.3.1 Outlet Boxes in Hazardous (Classified) Locations

UL 886.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, 3-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A. Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be urea or phenolic, minimum 0.03-inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03-inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, No. 1121 for single pole, No. 1122 for double pole, No. 1123 for three-way, and No. 1124 for four-way, totally enclosed with bodies of thermosetting plastic and mounting strap with grounding screw. Handles shall be ivory. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6-watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green, jewels for other purposes shall be red.

2.8.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 4, enclosure inside and NEMA 4X enclosures outside and in vaults per NEMA ICS 6.

2.9 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.9.1 Duplex Receptacles

Duplex receptacles shall be 15 amperes, 125 volts, No. 5242.

2.9.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.9.3 Ground-Fault Circuit Interrupter (GFI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFI devices.

2.9.4 Receptacles in Hazardous (Classified) Locations

UL 1010.

2.10 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated of 10,000 amperes symmetrical minimum. Panelboards for use as service

disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).

2.10.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. Panelboard LP1 shall feed power through to PP1.

2.10.1.1 Panelboard Neutrals for Non-Linear Loads

UL listed, and panelboard type shall have been specifically UL heat rise tested for use on non-linear loads. Panelboard shall be heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing. Verification of the testing procedure shall be provided upon request. Two neutral assemblies paralleled together with cable is not acceptable. Nameplates for panelboard rated for use on non-linear loads shall be marked "SUITABLE FOR NON-LINEAR LOADS". Provide a neutral label with instructions for wiring the neutral of panelboards rated for use on non-linear loads.

2.10.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.10.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.10.2.2 Circuit Breaker With GFI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A, GFI devices, for personnel protection, and 20 milliamperes or greater per requirements of UL 943 for Class B GFI per equipment protection.

2.11 MINI POWER CENTER

2.11.1 General

Transformer, primary and secondary main circuit breakers, and secondary panelboard section enclosed in NEMA 250, Type 3R enclosure.

2.11.2 Transformer

- a. Type: Dry, self-cooled, encapsulated.
- b. Insulation: Manufacturer's standard, with UL 1561 temperature rise.
- c. Full capacity, 2-1/2 percent voltage taps, two above and two below normal voltage.
- d. Primary Voltage: 480, three-phase.
- e. Secondary Voltage: 208/120 volts, three-phase, four-wire.
- f. Rating: 30 kVA.

2.11.3 Panelboard

- a. Full, UL 489, short-circuit current rated.
- b. Type: Thermal-magnetic, quick-make, quick-break, indicating, with noninterchangeable molded case circuit breakers.
- c. Maximum number of 1 pole or 3 pole circuit breakers: 24 (one pole) or 3 (three poles).

2.12 RESIDENTIAL LOAD CENTERS

2.12.1 Circuit Breakers

2.12.1.1 Multiple Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any two adjacent breaker poles are connected to alternate phases in sequence.

2.12.1.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices.

2.13 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.13.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class time delay-type. Associated fuseholders shall be Class R only.

2.13.2 Cartridge Fuses, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amps, Class L for 601 to 6,000 amps, and Class CC for zero to 30 amps.

2.13.3 Cartridge Fuses, Current Limiting Type (Class T)

UL 198H, Class T for zero to 1,200 amps, 300 volts; and zero to 800 amps, 600 volts.

2.14 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.15 MOTORS

NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Provide motors in hazardous locations with classifications as indicated.

2.15.1 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.16 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have

undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes.

2.16.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. One secondary lead shall be fused; other shall be grounded.

2.16.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.16.3 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.16.4 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.16.5 Terminal Blocks

NEMA ICS 4.

2.17 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Double pole designed for surface mounting with overload protection and pilot lights.

2.18 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2. Wiring shall be Class I, Type B, in NEMA Type 3R enclosure. Provide control centers suitable for operation on 480-volt, 3-phase, 3-wire, 60 Hz system and shall have minimum short-circuit withstand and interrupting rating of 25,000 amperes rms symmetrical. Incoming power feeder shall be cable entering at the top of enclosure and terminating on main protective device. Main protective device shall be molded case circuit breaker. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.18.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 25,000 amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.18.1.1 Horizontal and Main Buses

Horizontal bus shall have continuous current rating of 600 amperes. Main bus shall be copper, silver-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.18.1.2 Vertical Bus

Vertical bus shall have continuous current rating of 450 amperes, and shall be copper, silver-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.18.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.18.2 Motor Disconnecting Devices and Controllers

Shall comply with paragraph entitled "Combination Motor Controllers."

2.18.3 Combination Motor Controllers

UL 508 and other requirements in paragraph entitled, "Motor Controllers." Controller shall employ molded case circuit breaker. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes. Circuit breakers for combination controllers shall be thermal magnetic.

2.19 ADJUSTABLE FREQUENCY DRIVES

2.19.1 Definitions

Terms that may be used in this section:

- a. AFD: Adjustable frequency drive.
- b. CMOS: Complementary metal oxide semiconductor.
- c. CSI: Current Source Inverter.

- d. GTO: Gate Turn-Off Thyristor.
- e. PWM: Pulse width modulation.
- f. ROM: Read only memory.
- g. Rated Load: Load specified for the equipment.
- h. Rated Speed: Nominal rated (100 percent) speed specified for the equipment.
- i. TDD: Total demand distortion.
- j. THD: Total harmonic distortion.
- k. TTL: Transistor transistor logic.

2.19.2 System Description

a. Performance Requirements:

1. Rated Continuous Operation Capacity: Not less than 1.15 times full load current rating of driven motor, as indicated on the motor nameplates, and suitable for continuous operation at any continuous overload which may be imposed on motor by driven pump operating over specified speed range.
2. Current Harmonic Distortion: Compute individual and total current harmonic distortion at the Motor Control Center main bus in accordance with IEEE Standard 519.
3. Voltage Harmonic Distortion: Compute voltage harmonic distortion at Motor Control Center main bus. THD shall not exceed 5 percent, and individual voltage harmonic distortion shall not exceed 3 percent.
4. Furnish series reactors for proper system operation. Furnish necessary devices and circuits to prevent operation of one drive from adversely affecting operation of other drives supplied from same transformer or same bus.

b. Design Requirements:

1. Design and provide drive system consisting of adjustable frequency controller, drive motor, certain auxiliary items, and components necessary for complete operating system.
2. Other equipment is being powered from same bus as adjustable frequency drives. Ensure proper operation of drives and other loads under normal conditions.
3. Furnish AFDs rated on basis of actual motor full load nameplate current rating.
4. Drive System: Convert incoming three-phase, 60-Hz ac power to variable voltage, adjustable frequency output for adjustable speed operation of a standard ac induction squirrel-cage motor, using the pulse-width-modulation (PWM) technique to produce the

adjustable frequency output.

5. Incoming Line Circuit Breaker: Provide positive means of disconnecting incoming power, and overcurrent protection for the drive system.

6. Incoming Line Reactor: Design to minimize harmonic distortion on the incoming power feeder.

2.19.3 Submittals

a. Shop Drawings

1. Overall drive system operating data, including input currents, and power factors, at rated system input voltage, at 100 percent of rated speed.

2. AFD output pulse maximum peak voltage, pulse rise time and pulse rate of rise, including any justification for proposed deviation from specified values. Include motor manufacturer's certification that motor insulation will withstand long-term overvoltages caused at motor terminals due to specified output pulse data or any proposed deviation from this data. Provide output reactors or filters.

3. Complete system rating, including all nameplate data, continuous operation load capability throughout speed range of 0 to 120 percent of rated speed.

4. Complete adjustable frequency controller rating coordinated with motor full load nameplate current rating; list any controller special features being supplied.

5. Controller, reactor, dimensional drawings; information on size and location of space for incoming and outgoing conduit.

6. Layout of controller face showing pushbuttons, switches, instruments, indicating lights, etc.

7. Complete system operating description.

8. Complete system schematic (elementary) wiring diagrams.

9. Complete system interconnection diagrams between controller, drive motor, and all related components or controls external to system, including wire numbers and terminal board point identification.

10. One-line diagram of system, including component ratings.

11. Description of diagnostic features being provided.

12. Descriptive literature for all control devices such as relays, timers, etc.

13. Itemized bill-of-materials listing all system components.

b. Quality Control Submittals

1. Statement of Supplier qualifications.
2. Factory functional test reports.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Field test reports.
6. Manufacturer's Certification of Proper Installation.
7. Suggested spare parts list. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
8. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Operation and maintenance manual.

2.19.4 Quality Assurance

Supplier: Minimum 5 years' experience in furnishing similar size and type adjustable frequency, controlled speed, drive systems.

2.19.5 Extra Materials

Furnish for each drive unit:

- a. Complete set of components likely to fail in normal service.
- b. Plug-in subassemblies.
- c. Printed circuit boards.
- d. SCRs.
- e. Potentiometers.
- f. Integrated circuits.
- g. One complete power bridge and one spare printed circuit card for each modular, plug-in type card in controller.

2.19.6 Supplements

Some specific requirements are attached to this section as supplements.

2.19.7 Service Conditions

- a. Ambient Operating Temperature: 32 to 104 degrees F.
- b. Storage Temperature: Minus 40 to 158 degrees F.
- c. Humidity: 0 to 95 percent relative (noncondensing).

- d. Altitude: 0 to 3,300 feet.
- e. Frequency Stability: Plus or minus 0.1 percent of maximum frequency.

2.19.8 Components

a. Drive Units

1. Incorporate a switching power supply operating from a dc bus, to produce a PWM output waveform simulating a sine wave and providing power loss ride through of 2 milliseconds at full load, full speed.
2. Current-limiting semiconductor fuses for protection of internal power semiconductors.
3. Employ a diode bridge rectifier providing a constant displacement power factor of 0.95 minimum at all operating speeds and loads.
4. Use transistors for output section, providing a minimum 97 percent drive efficiency at full speed, full load.
5. Employ dc power discharge circuit so that after removal of input power dc link capacitor voltage level will decay below 50 volts dc within 1 minute after de-energizing following NEMA CP 1 and NFPA 79.
6. Operate with an open circuited output.
7. Input Voltage: 208V ac plus or minus 10 percent.
8. Output Voltage: 0 to 208 volts, three-phase, 0 to 66-Hz, minimum.
9. Short-Time Overload Capacity: 125 percent of rated load in rms current for 1 minute following full load, full speed operation.
10. Equipment Short-Circuit Rating: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 10,000 amps rms symmetrical at 208 volts.
11. Furnish drives with output current-limiting reactors mounted within equipment enclosure.
12. Diagnostics: Comprehensive for drive adjustment and troubleshooting:
 - a) Memory battery backup; 100-hour minimum during a power loss.
 - b) Status messages will not stop drive from running but will prevent it from starting.
 - c) Fault Condition Messages and History: First fault protection function to be activated, ability to store six successive fault occurrences in order. Minimum faults numerically:
 - 1) Overcurrent (time and instantaneous).
 - 2) Overvoltage.
 - 3) Undervoltage (dc and ac).

- 4) Overtemperature (drive, motor windings, motor bearing, pump bearing).
- 5) Serial communication fault.
- 6) Short-circuit/ground fault (motor and drive).
- 7) Motor stalled.
- 8) Semiconductor fault.
- 9) Microprocessor fault.
- 10) Single-phase voltage condition.

13. Drive Protection

- a) Fast-acting semiconductor fuses.
- b) Overcurrent, instantaneous overcurrent trip.
- c) Dc undervoltage protection, 70 percent dropout.
- d) Dc overvoltage protection, 130 percent pickup.
- e) Overtemperature, drive, inverter, converter, and dc link components.
- f) Overtemperature, motor, and pump.
- g) Single-phase protection.
- h) Reset overcurrent protection (manual or automatic reset).
- i) Active current limit/torque limit protection.
- j) Semiconductor fault protection.
- k) Short-circuit/ground fault protection.
- l) Serial communication fault protection.
- m) Microprocessor fault.
- n) Surge protection for transient overvoltage (6,000 volts, 80 joule surge, tested per ANSI/IEEE C62.41).
- o) Visual display of specific fault conditions.

14. Operational Features

- a) Use manufacturer's standard unless otherwise indicated.
 - b) Sustained power loss.
 - c) Momentary power loss.
 - d) Power interruption.
 - e) Power loss ride through (0.1 second).
 - f) Start on the fly.
 - g) Electronic motor overload protection.
 - h) Stall protection.
 - i) Slip compensation.
 - j) Automatic restart after power return (ability to enable/disable function).
 - k) Critical frequency lockout (three selectable points minimum, by 1.5-Hz steps in 10-Hz bands, to prevent resonance of system).
 - l) Drive maintenance system software for complete programming and diagnostics.
 - m) Ground fault protection, drive, and motor.
 - n) Operate with no motor connected to output terminals.
- b. Rectifier: Three-phase 6-pulse full wave diode bridge rectifier to provide a constant dc voltage to the drive's dc bus.
- c. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

- d. Controller: Controller: Microprocessor-controller PWM inverter to convert to dc voltage to variable voltage, adjustable frequency three-phase ac output. The output voltage shall vary proportionally with the frequency to maintain a constant ratio of volts to hertz up to 60-Hz. Above 60-Hz, the voltage shall remain constant, with the drive operating in a constant horsepower output mode.

e. Enclosure

1. NEMA 250, Type 4X, gasketed enclosure for wall mounting, completely front accessible, and hinged doors. Properly sized to dissipate heat generated by controller within limits of specified operating conditions (including ambient temperature and ambient airflow). Enclosure not to exceed dimensions shown on Drawings.
2. Furnish drive complete with cable termination compartment door interlocked main circuit breaker, defeatable (lockable in the open position), emergency stop pushbutton, alphanumeric keypad and display, and operator's controls.

f. Operator Interface

1. Controls: Mount drive local control on front door of enclosure and include control switch and membrane type keypad for the following operator functions:

- a) Start (when in local mode).
- b) Stop (when in local mode).
- c) Speed increase (when in local mode).
- d) Speed decrease (when in local mode).
- e) Parameter mode selection (recall programmed parameters).
- f) LOCAL/OFF/REMOTE control selection (in remote, furnish for remote RUN command digital input and speed increase/decrease via remote 4 to 20 mA analog signal).
- g) Fault reset, manual for all faults (except loss of ac voltage which is automatic upon return).
- h) RUN/preset speed.
- i) Parameter lock (password or key switch lockout of changes to parameters).
- j) Start disable (key switch or programmed code).

2. 120 volts, single-phase, 60-Hz circuits for control power and operator controls from internal control power transformer. Furnish power for motor space heaters rated 120 volts.

3. Arrange component and circuit such that failure of any single component cannot cause cascading failure(s) of any other component(s).

4. Alphanumeric Display: During normal operation and routine test, the following parameters shall be available:

- a) Motor current (percent of drive rated current).
- b) Output frequency (Hertz).
- c) Output voltage.
- d) Running time.

- e) Local/remote indicator.
- f) Status of digital inputs and outputs.
- g) Analog input and output values.
- h) Output motor current per leg.
- i) All test points.

5. Adjustable Parameters: Set drive operating parameters and indicate in a numeric form.

Potentiometers may not be used for parameter adjustment. Minimum setup parameters available:

- a) Frequency range, minimum, maximum.
- b) Adjustable acceleration/deceleration rate.
- c) Volts per Hertz (field weakening point).
- d) Active current limit/torque limit, 0 to 140 percent of drive rating.
- e) Adjustable voltage boost (IR compensation).
- f) Preset speed (adjustable, preset operating point).
- g) Provision for adjustment of minimum and maximum pump speed to be furnished as function of 4 to 20 mA remote speed signal.

g. Signal Interface

1. Digital Input

- a) Accept a remote RUN command contact closure input.
- b) High temperature contact closure input from field mounted motor temperature monitoring relay.

2. Digital Output: Furnish three discrete output dry contact closures rated 5 amps at 120V ac.

- a) DRIVE RUNNING.
- b) DRIVE FAULT (with common contact closure for all fault conditions).
- c) DRIVE IN REMOTE MODE.

3. Analog Input: When LOCAL/OFF/REMOTE switch is in REMOTE, control drive speed from a remote 4 to 20 mA dc signal. Make provisions for adjustment of minimum and maximum motor speed which shall result from this signal. Factory set this adjustment to comply with operating speed range designated in driven equipment specifications. Frequency resolution shall be 0.1 percent of base speed.

4. Analog Output: Furnish two 4 to 20 mA dc signals, for actual frequency, actual load.

h. Accessories

1. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

2. Lifting Lugs: Equipment weighing over 100 pounds.

3. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05500, METAL FABRICATIONS.

2.19.9 Factory Finishing

a. Enclosure

1. Primer: One coat of rust-inhibiting coating.

2. Finish

a) Interior: One coat white enamel.

b) Exterior: One coat manufacturer's standard gray enamel or ANSI 359-A-1-88, No. 61.

3. Manufacturer's standard finish.

2.19.10 Source Quality Control

Functional Test: Perform manufacturer's standard.

2.19.11 Installation

Install in accordance with manufacturer's printed instructions.

2.19.12 Field Quality Control

a. Functional Test

1. Conduct on each controller.

2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.

3. Record test data for report.

b. Performance Test

1. Conduct on each controller.

2. Perform under actual or approved simulated operating conditions.

3. Test for continuous 12-hour period without malfunction.

4. Demonstrate performance by operating the continuous period while varying the application load, as the input conditions allow, to verify system performance.

5. Record test data for report.

6. At the Motor Control Center main bus, measure the following to show parameters within specified limits:

a) Total and individual current harmonic distortion (up to and

including 35th harmonic), under following load conditions:

- 1) AFDs running at full load.
- b) Total voltage harmonic distortion under following conditions:
 - 1) AFDs running at full load.

c. Test Equipment

1. Use Dranetz, Model No. 626-PA, harmonic distortion monitor and Series 626 disturbance analyzer or equivalent instrument to document results.
2. Provide diagnostic plug-in test card complete with instructions, multiposition selector switch, and meters or built-in diagnostic control panel or ROM-based processor for monitoring ac, dc, and digital signals to assist in troubleshooting and startup of drive.

2.19.13 Manufacturer's Services

- a. Manufacturer's Representative: Present at site or classroom designated by OWNER, for minimum person-days listed below, travel time excluded:
 1. 3 person-days for installation assistance and inspection.
 2. 3 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
 3. 1 person-day for prestartup classroom or site training.
 4. 1 person-day for facility startup.
 5. 1 person-day for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

2.20 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and telephone cabinets.

2.20.1 Outlet Boxes for Telephone System

Standard type, as specified herein. Mount flush in finished walls at height specified for outlet receptacles. Outlet boxes for wall-mounted telephones shall be 2 inches by 4 inches by 1-1/2 inches deep; mounted at height 60 inches above finished floor.

2.20.2 Cover Plates

Blank cover with same finish specified for receptacle and switch cover plates.

2.20.3 Conduit Sizing

Conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch. Size conduits for telephone risers to

telephone cabinets, junction boxes, distribution centers, and telephone service, as indicated.

2.20.4 Backboards

Interior grade plywood, 3/4-inch thick, 4 by 8 feet minimum. Paint with gray water-based paint.

2.20.5 Terminal Cabinets

Construct of zinc-coated sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with 5/8-inch backboard having a two-coat insulating varnish finish. Match trim, hardware, doors, and finishes to lighting panelboards.

2.21 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.22 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.23 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.24 HEAT TRACE

Heat tracing system shall be provided as shown on the Plans. The heat tracing cable shall be the self-regulating type--Raychem Chemelex BTV. The heat tracing cable shall be switched on and off based on pipe temperature by a bulb and capillary type thermostat in NEMA 7 enclosure. The heat tracing cable shall be capable of maintaining a pipe temperature of 50 degrees F in 0 degree F ambient. The heat tracing system shall also include an additional adjustable thermostat with capillary bulb which shall be used for remote monitoring purpose. The circuit breakers feeding the heat tracing circuit shall be sized so that inrush current, when calculated at 0 degrees F, will not overload the breaker or feeder. The heat tracing cable shall be sized based upon the manufacturer's heat tracing design guides, the pipe insulation and the cable heating capability. Heat trace shall be suitable for Class 1, Division 2--Hazardous location.

2.25 WIREWAYS

UL 870. Material shall be steel galvanized 16 gage for sizes 6 by 6 inches. Provide in length indicated for application with hinged cover NEMA 3R enclosure per NEMA ICS 6.

2.26 METERING

Provide a self-contained, socket-mounted, electronic programmable outdoor watthour meter. Meter shall either be programmed at the factory or shall be programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to ANSI C12.16.

- a. Design: Provide watthour meter designed for use on a three-phase, 4-wire, 480Y/277 volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).
- b. Class: 20

Form: 9S, accuracy: +/- 1.0 percent
Finish: Class II
- c. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.
- d. Kilowatt-hour Register: 5 digit electronic programmable type.
- e. Demand Register:
 - 1. Provide solid state ANSI C12.15.
 - 2. Meter reading multiplier: Indicate multiplier on the meter face.
 - 3. Demand interval length: shall be programmed for 30 minutes with rolling demand up to six subintervals per interval.
- f. Socket: ANSI C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Provide manufacturers standard enclosure color unless otherwise indicated.
- g. Coordination: Provide meter coordinated with ratios of current transformers and transformers secondary voltage.
- h. Current transformers: ANSI/IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

Name	kVA	Sec. Volt	CT Ratio	RF	Meter Acc. Class
T24	500	480	600/5	3	0.3 thru B-0.5

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to

requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Hazardous Locations

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.4 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, or rigid nonmetallic conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped.

3.1.4.1 Restrictions Applicable to Aluminum Conduit

Do not install underground or encase in concrete or masonry. Do not use brass or bronze fittings.

3.1.4.2 Restrictions Applicable to EMT

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.
- c. Do not use in areas subject to severe physical damage including

but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

- d. Do not use in hazardous areas.
- e. Do not use outdoors.
- f. Do not use in fire pump rooms.

3.1.4.3 Nonmetallic Conduit

- a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

3.1.4.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.4.5 Service Entrance Conduit, Overhead

Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.

3.1.4.6 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.4.7 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.4.8 Conduit in Floor Slabs

PVC, Type EPC-40, unless indicated otherwise.

3.1.4.9 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.5 Conduit Installation

Unless indicated otherwise, expose conduit along walls. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water

pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.5.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.5.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.5.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems must be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.5.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.5.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.5.6 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for

trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one-inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit in terminal cabinet with two locknuts and plastic bushing.

3.1.5.7 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.5.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.5.9 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations or equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.6 Busway Installation

Installation shall comply at minimum with NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5-foot maximum intervals, and brace to prevent lateral movement. Hinges provided on risers shall be fixed type; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and caulk. Provide expansion joints, but only where bus duct crosses building expansion joints.

3.1.7 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, or when installed in hazardous areas and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for

mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.7.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4- by 2-inch boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 inches square by 1 1/2 inches deep.

3.1.7.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.8 Mounting Heights

Mount panelboards, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.9 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates;

or heat shrink-type sleeves.

3.1.10 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.11 Terminating Aluminum Conductors

3.1.11.1 Termination to Copper Bus

Terminate aluminum conductors to copper bus either by: (a) inline splicing a copper pigtail, of ampacity at least that of aluminum conductor, or (b) utilizing circumferential, compression-type, aluminum-bodied terminal lug UL listed for AL/CU, and steel Belleville cadmium-plated hardened steel spring washers, flat washers, bolts, and nuts. Carefully install Belleville spring washers with crown up toward nut or bolt head, with concave side of Belleville bearing on heavy-duty, wide series flat washer of larger diameter than Belleville. Tighten nuts sufficiently to flatten Belleville, and leave in position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

3.1.12 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.13 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, and ceilings utilizing proper firestopping materials to maintain fire resistive integrity.

3.1.14 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.14.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms

under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.14.2 Telephone Service

Provide main telephone service equipment ground consisting of separate No. 6 AWG ground wire in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.15 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.16 Elevator

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at midheight of elevator shaft, and work light and outlet receptacle in elevator pit.

3.1.17 Repair of Existing Work

3.1.17.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.17.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.17.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source.

3.1.17.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to tests.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform test classified as routine in accordance with NEMA ST 20 on each transformer.

3.2.4 GFI Receptacle Test

Test GFI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.2.6 Watthour Meter

a. Visual and Mechanical Inspection

1. Examine for broken parts, shipping damage, and tightness of connections.
2. Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical Tests

1. Determine accuracy of meter.
2. Calibrate watthour meters to one-half percent.
3. Verify that correct multiplier has been placed on face of meter, where applicable.

-- End of Section --

SECTION 16510

INTERIOR LIGHTING

03/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt, S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1990) Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1377	(1990) Electric Lamps - 175-Watt, M57 Single-Ended Metal-Halide Lamps
ANSI C78.1378	(1990) Electric Lamps - 250-Watt M58 Single-Ended Metal-Halide Lamps
ANSI C82.11	(1993) High-Frequency Fluorescent Lamp Ballasts

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	(1993) Lighting Handbook, Reference and Application
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 101	(1994) Code for Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	(1986; Errata 1988, R 1993, Bul. 1993) General-Use Snap Switches
UL 595	(1985; R 1991, Bul. 1991, 1993, and 1994)

	Marine-Type Electric Lighting Fixtures
UL 773	(1987; R 1992, Bul. 1994) Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(1995) Nonindustrial Photoelectric Switches for Lighting Control
UL 844	(1995) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	(1995; R 1995, Bul. 1995) Emergency Lighting and Power Equipment
UL 935	(1995) Fluorescent-Lamp Ballasts
UL 1570	(1988; Bul. 1991, 1993, and 1994, R 1994) Fluorescent Lighting Fixtures
UL 1571	(1991; Bul. 1992, 1993, and 1994, R 1994) Incandescent Lighting Fixtures

FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC-150/5345-43 (Rev. D) Obstruction Lighting Equipment

MILITARY SPECIFICATIONS (MIL)

MIL-L-7830 (Rev. D) Light Assembly, Marker, Aircraft Obstruction

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Distribution System." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Submit the following in accordance with Section C, Part 7 of the Basic Contract. Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-02, Manufacturer's Catalog Data

- a. Fluorescent lighting fixtures G
- b. Fluorescent lamp electronic ballasts G
- c. Fluorescent lamps G
- d. Metal-halide lamps G
- e. Exit signs G
- f. Emergency lighting equipment G
- g. Obstruction light G
- h. Lighting contactor G

1.4.2 SD-12, Field Test Reports

- a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.4.3 SD-18, Records

- a. Information card G

1.4.3.1 Information Card

For each electronic ballast manufacturer used in the construction, furnish a typewritten card, laminated in plastic. Card shall be 8 1/2 by 11 inches minimum and shall contain the information listed on Form 1 located at the end of this section. The card shall be turned over to the officer in charge of construction with warranty and equipment information. Send a photostatic paper copy to LANTNAVFACENGCOM, Code 1613, 1510 Gilbert Street, Norfolk, VA 23511-2699.

1.5 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

- a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.
- b. Power factor shall be 0.95 (minimum). Lamp current crest factor shall be 1.7 (maximum).
- c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).
- d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.
- e. Ballast shall be UL listed Class P with a sound rating of "A."
- f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Ballast lamp lead wire color code shall comply with ANSI C82.11 for parallel or independent lamp operation.
- g. Ballast shall operate in an instant start mode.
- h. Ballast factor shall be 85 percent (minimum).
- i. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

- a. Ballast shall be capable of starting and maintaining operation at a minimum of 50 degrees F for F32T8 lamps, unless otherwise indicated. When indicated, ballast shall be capable of starting and maintaining operation at a minimum of zero degrees F for F32T8 lamps.
- b. Total harmonic distortion (THD): Shall be 15 percent (maximum).
- c. Input wattage.

(1) 32 watts (maximum) when operation on F32T8 lamp.

2.1.2 Fluorescent Lamps

T-8 rapid start 48 inch lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

2.1.3 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp).
Provide lamps with shatter resistant coating, non-yellowing, nominal
thickness of 15 mils, and with 97 percent (minimum) light transmission.

2.1.4 Metal-Halide Lamps

- a. 175 watt conforming to ANSI C78.1378.
- b. 250 watt conforming to ANSI C78.1375.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

2.2.1 High-Pressure Sodium (HPS) Lamps

HPS lamps shall be:

- a. 150 watt, 55 volt conforming to ANSI C78.1355

2.2.2 Metal Halide Lamps

- a. 175 watt conforming to ANSI C78.1377
- b. 250 watt conforming to ANSI C78.1378

2.3 INCANDESCENT LIGHTING FIXTURES

UL 1571.

2.3.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.3.2 Incandescent Dimmer Switch

UL 20, single-pole, 600 watt, 120 volt ac, full-range rotary on-off type
with built-in electromagnetic interference filter.

2.4 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall
be from the bottom. Trim for the exposed surface of flush-mounted fixtures
shall be as indicated.

2.5 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures
supported by hangers. Provide with swivel hangers to ensure a plumb
installation. Hangers shall be cadmium-plated steel with a swivel-ball
tapped for the conduit size indicated. Hangers shall allow fixtures to
swing within an angle of 20 degrees. Brace pendants 4 feet or longer
provided in shops or hangers to limit swinging. Single-unit suspended
fluorescent fixtures shall have twin-stem hangers. Multiple-unit or
continuous row fluorescent fixtures shall have a tubing or stem for wiring
at one point and a tubing or rod suspension provided for each unit length
of chassis, including one at each end. Rods shall be a minimum 0.18 inch
diameter.

2.6 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide fluorescent fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated. [Fixture shall also conform to UL 595 for marine environments as indicated].

2.7 LIGHTING CONTACTOR

NEMA ICS 2, electrically held contactor. Contacts shall be rated 208 volts, 30 amperes, and 3 poles. Coils shall be rated 208 volts. Rate contactor as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts. Provide contactor with on-off selector switch.

2.8 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide cell rated 120 volts ac, 60 Hz with single pole double-throw (SPDT) contacts for control of mechanically held contactors rated 1000 watts, and 120 volts. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

- a. in a cast weatherproof aluminum housing with adjustable window slide.

2.9 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type.

2.9.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum).

2.10 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated. Provide accessories required for remote-mounted lamps where indicated. Remote-mounted lamps shall be as indicated.

2.10.1 Emergency Lighting Unit

Provide as indicated. Emergency lighting units shall be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted lamps may be rated 6 volts. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage. Provide integral self-testing module.

2.11 AUXILIARY INSTANT-ON QUARTZ SYSTEM

UL listed, automatically switched instant-on 250 watt quartz lamp. Quartz lamp shall come on when luminaire is initially energized and following a momentary power outage and shall remain on until HID lamp reaches

approximately 60 percent light output. Wiring for quartz lamp shall be internal to the ballast and shall be independent of the incoming line voltage to the ballast. Provide instant-on quartz system as indicated.

2.12 OBSTRUCTION MARKER LIGHTS

FAA AC-150/5345-43, Type L-810, or MIL-L-7830. Obstruction marker lights shall emit a steady burning aviation red light. Provide light assembly supplied by a series circuit power adapter as recommended by the obstruction light manufacturer. Provide double-unit type obstruction marker lights. Provide control for obstruction marker lights on elevated storage tank.

2.13 LAMPS AND FILTERS

Provide lamps of size and type indicated, or required by fixture manufacturer for each lighting fixture required under this contract. Provide filters as indicated and conforming to the specification for the light concerned or to the standard referenced.

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Provide wires or rods for lighting fixture support in this section.

3.1.1 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.3 OBSTRUCTION MARKER LIGHTS

Install obstruction marker lights on radio towers, elevated water tanks, smokestacks, buildings, and similar structures with 1-inch zinc-coated rigid steel conduit stems using standard tees and elbows, except that where lowering devices are required, install in accordance with equipment manufacturer's recommendations.

-- End of Section --